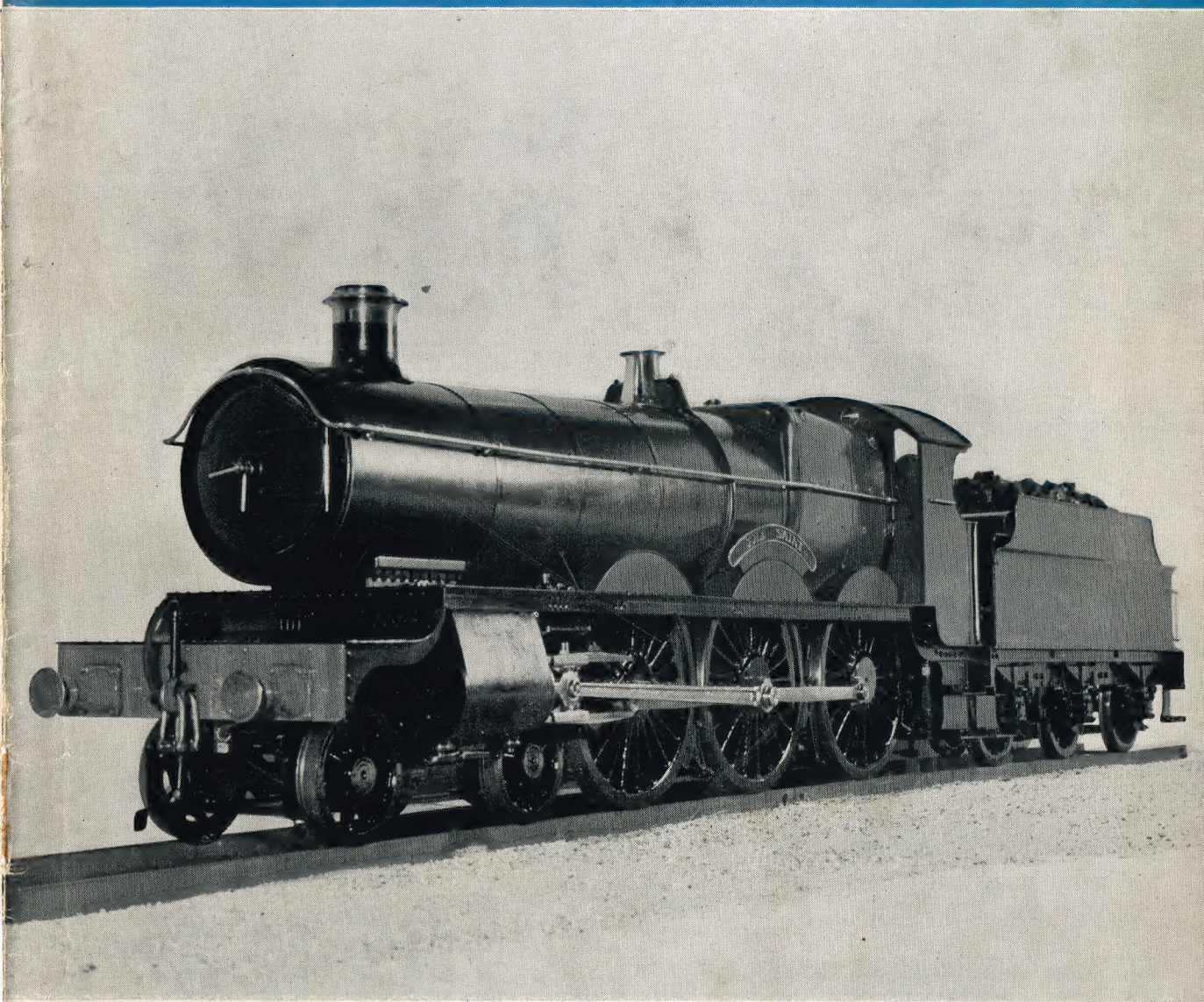
THE MODEL ENGINEER



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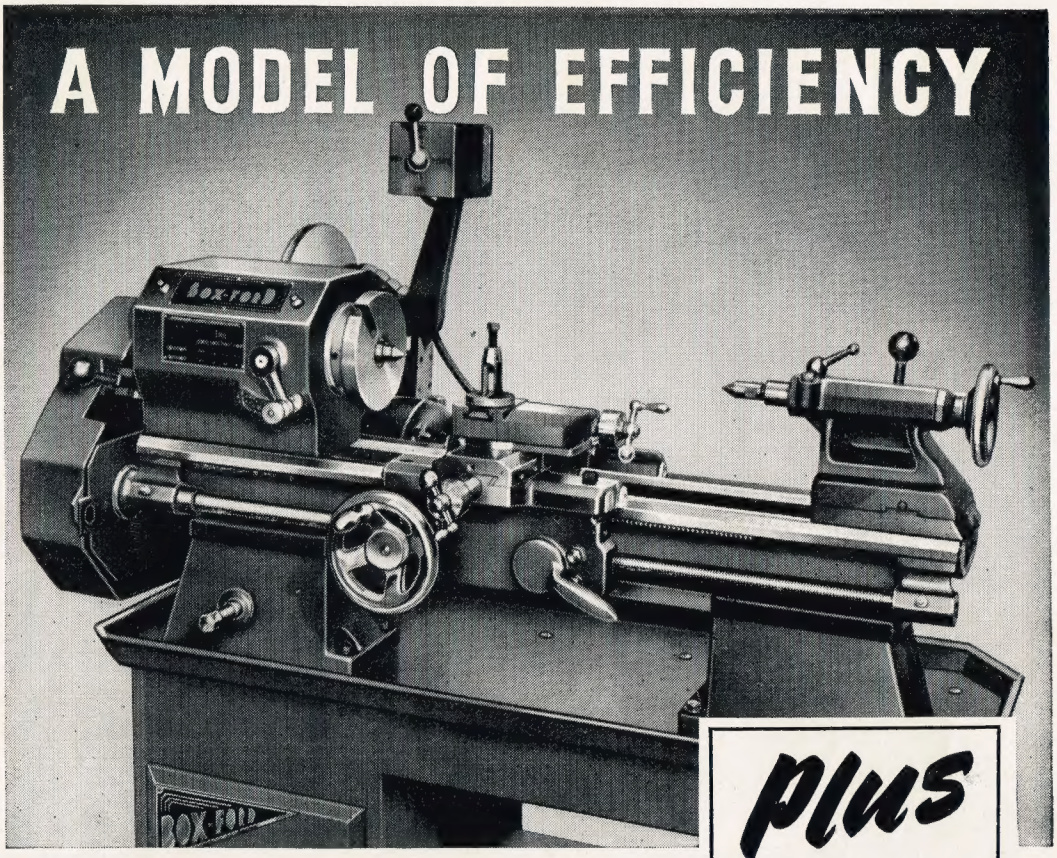
HOW THE ROLLS-ROYCE WAS BORN ● READERS' LETTERS

MARCH 25th 1954
Vol 110 No. 2757

9D

A MODEL OF EFFICIENCY



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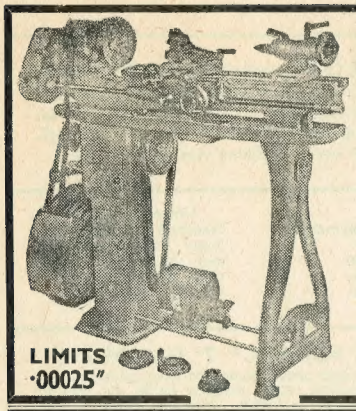

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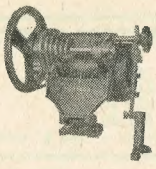

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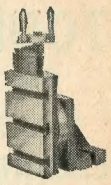

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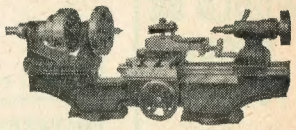

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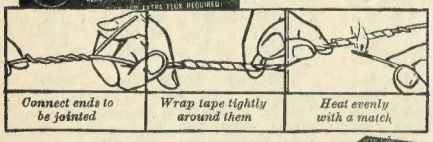

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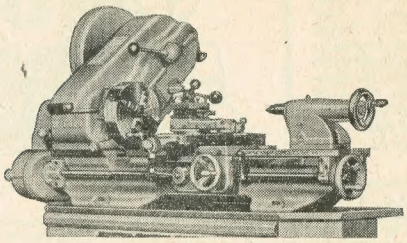

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Vol. I March 1954 No. 3

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Vee Blocks. (5807) 3" × 1½" × 1¼", 5s. 3d. ; (5808) 4" × 2" × 1¼", 6s. 6d.

Carriers and Dogs. (5809) set (4) faceplate dogs, 2½", 5s. ; (5813) set (3) straight tail carriers, ½", ⅝", 1", 11s. 6d.

Lathe Tools. Sets H.S. slide rest tools (5816) eight 5/16" sq., 32s. ; (5817) twelve ⅜" square, 87s. (27s. deposit, 16s. monthly). Sets of handle tools : (5819) 6 for metal, 23s. 3d. For wood (5820) 3, 17s. 9d. ; (9471) 5, 30s. ; (9789) 6, 28s. 3d. ; (9470) 8, 49s.

Milling Cutters. High speed, all 2" dia. × ½" bore. Side and face : (5969) ½", 46s. 3d. ; (5970) 5/16", 47s. 6d. ; (5971), ⅝", 48s. 9d. ; (5972) 7/16", 50s. ; (5973) ½", 51s. 6d. Slotting : (5974) ½", 29s. ; (5975) 5/16" 30s. ; (5976) ⅝", 31s. 3d. Milling arbor for above (5818) 35s.

Sundries. (5822) Dewhurst (Forward-off-Reverse) drum pattern switch, 25s. 4d. ; (5861) switch bracket, 9s. ; (5823) Shell Vitrea Oil, gallon tin, 9s. 9d. ; (5815) boring bar, 13", with 3 cutters, 27s. 6d.

"SUPER-SEVEN"

Lathe. (9402) Myford "Super-Seven" 3½" × 19" high speed centre lathe complete with standard equipment comprising : 6¼" faceplate, catchplate, 4" backplate, 14 changewheels, spanners and key, oil gun, centres, guards, belts and motor pulley, leadscrew handwheel and pointer (less motor), £69 10s., (£17 10s. deposit, 92s. 3d. or 64s. 2d. or 50s. 2d. monthly.

Accessories. (9409) fine feed tumbler cluster gear, bronze, 19s. For balance of accessories and attachments refer to "ML7" below.

"ML7"

Lathe. (6045) Myford "ML7" 3¼" × 20" heavy duty bench lathe complete with standard equipment comprising : 6¼" faceplate, set (14) changewheels, guards, spanners, sight feed lubricators, grease gun, self-contained drive unit, 4" backplate, belt guard and motor pulley (less motor), £48 5s. (£12 5s. deposit, 68s. 4d. or 48s. 4d. monthly).

Cabinet Stand. Complete with screwcutting panel, reversing switch and wiring (less motor), £16 7s. 6d. (£4 7s. 6d. deposit, 24s. monthly).

Motor. (5603) Hoover Mark 2, 1/3 h.p., ball bearing, resilient mounted, £10 16s. 7d. (£2 16s. 7d. deposit, 16s. 0d. monthly) ; (1221) Brook "Gryphon Cub" 1/3 h.p., £7 16s. 3d. (£2 16s. 3d. deposit, 20s. monthly). Please state exact mains voltage.

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"ML7" & "S7" ACCESSORIES

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Connecting Rod Boring Fixture. (5829) with boring bar and three cutters, £6 10s. (50s. deposit, 16s. monthly).

Countershaft Clutch Unit. (9407) supplied complete with modified swing head, ready for immediate use, £6 10s. (50s. deposit, 16s. monthly), 15s. allowed on your old swing head if returned.

Four Tool Turret. (5830) £3 7s. 6d. (22s. 6d. deposit, 9s. monthly).

Collet Attachment. (5831) lever operated for spindle nose mounting. Supplied rough turned for finishing on lathe, complete with ⅝" collet, £9 17s. 6d. (77s. 6d. deposit, 24s. monthly). Extra collets : (5832) ¼", (5833) ½", (5834) ⅝" and multiples, 30s. 6d. each.

Steadies. (5836) fixed, 55s. ; (5837) travelling, 35s.

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Patent Collets. No. 2 M.T. for use in spindle nose (5847) ¼" ; (5848) 5/16" ; (5849) ⅜" ; (5850) 7/16" ; (5851) ½" ; (5852) 9/16" ; (5853) ⅝" ; 25s. 3d. each ; (5854 collet nosepiece, 15s. ; (5855) collet closing tube, 10s.

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(To be continued)

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THE MODEL ENGINEER

EVERY THURSDAY

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Our Cover Picture

Our G.W.R.-enthusiast readers will surely be pleased with the engine depicted on our cover this week; and we think that others who may not be G.W.R. enthusiasts will be just as astonished by it as we were when we first saw it working, but in an unfinished condition, about three years ago. For a detailed description by its builder, Mr. P. F. Arnold, of Slough, Bucks., we refer readers to page 310 in this issue; but the important point to note is that this well-nigh perfect little "portrait" in ¾-in. scale is a first attempt at locomotive building. The significance of the name is that the engine is not, and was not intended to be, a perfect replica of any one engine in the class; but it is thoroughly characteristic, with hardly a blemish anywhere. Moreover, we have seen it at work on more than one occasion, and could not rest content until we had given it the publicity of our pages.

SMOKE RINGS

"M.E." Reader's Success

THE ROYAL Society of Arts has published the results of its 1953 Industrial Art Bursaries Competition, and we are interested to note that the first name on the list of successful competitors is that of Mr. Peter Hammond, of Birmingham, whose winning essay dealt with Domestic Electrical Appliances. Mr. Hammond was the builder of that excellent model Birmingham tramcar depicted on the cover of THE MODEL ENGINEER for January 28th last.

Incidentally, the Royal Society of Arts announces that an exhibition of winning and commended designs will be held at 6-8, John Adam Street, Adelphi, London, W.C.2, between May 18th and June 4th next. Admission free. There will be some interesting exhibits, in view of the society's bi-centenary celebrations.

What is a Gas-engine ?

IN A letter published in a recent issue of the house-journal of the Institution of Engineers, Australia, a member calls attention to what he calls "a bad tendency becoming evident which members should use their influence and position to stamp out." It is the tendency to adopt the American word "gasoline" instead of the English word "petrol." He points out that "gasoline" is undesirable, not because it is so much worse than "petrol," but because it gets shortened to "gas," and then there is great confusion ; he asks : "What then is a 'gas-engine'?"

We can sympathise with this gentleman because, not only do we feel exactly as he does in the matter, but we have met the same difficulty over "gas-engine." It is true that, in Britain, it rarely arises in ordinary everyday life; but in commercial circles, it does often give rise to much confusion and consequent inconvenience, and we feel that this confusion and inconvenience ought not to be allowed to exist. We will not dogmatise on what is the best way of dealing with this matter; but we suggest that whatever proposal is made and adopted, it should not lose sight of the fact that England and America are not the only two English-speaking countries in the world; there are several others, like Australia, and most of them tend to adopt that which is best from both England and America. The term "gas-engine," for example, *should* mean the same thing in whatever English-speaking country it is used. Perhaps the members of the Institution of Engineers, Australia, can do something about it.

Hot-air Engines Wanted

THE BRIGHTON and Hove Society of Model Engineers are planning to hold an exhibition in the Corn Exchange, Brighton, from August 21st to 28th next, and among the attractions is to be, if possible, a stand devoted entirely to hot-air engines. Mr. S. R. Bostel is the owner of six, some of which are workable; but he would be glad to hear from any other owners who would be willing to help in adding to this display. Gas will be laid on to the stand so that any hot-air engine that can do so will be able to run at periodic intervals.

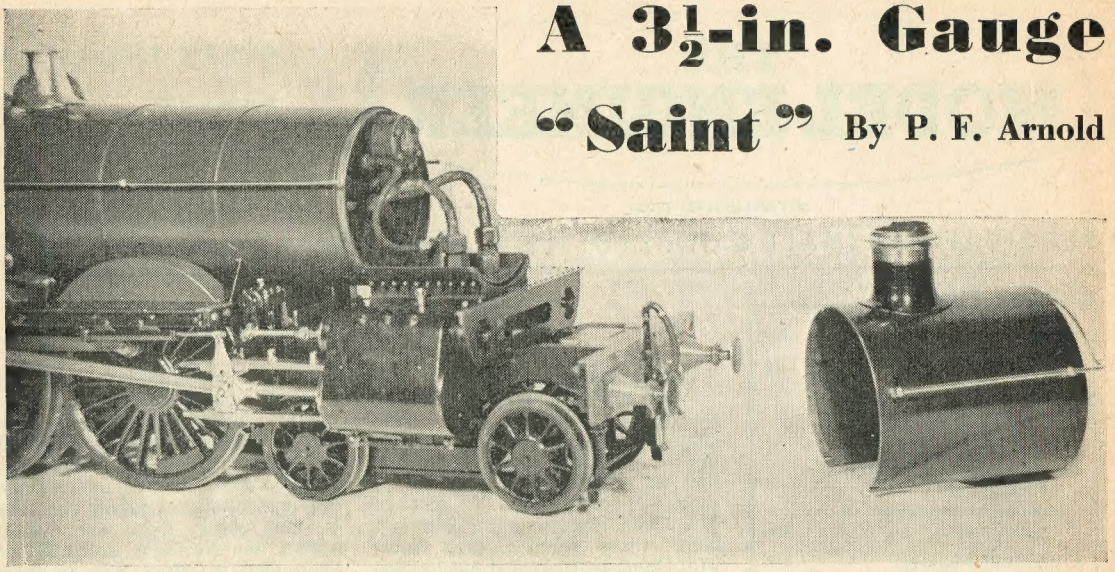
The hot-air engine is of interest to many of our readers, to judge by the correspondence that follows the publication of articles on the subject; also, we know of some readers who possess examples of the hot-air engine, in one or other of its various forms. If any of these owners are interested in Mr. Bostel's idea, he is invited to write to Bostel House, 8, Cranbourne Street, Brighton 1.

Calling Mr. Peter Anderson!

WILL MR. Peter Anderson, who was formerly in the R.A.F. at Warton, in Lancashire, and is building the Allchin "M.E." traction-engine, please contact Mr. W. J. Hughes through this office.

A 3½-in. Gauge "Saint"

By P. F. Arnold



View, showing loose sections of foot-plating and smokebox removed

THE engine illustrated, and on the cover of this issue, is a "first attempt," and occupied spare time over a period of nearly six years. Although built for hard work on the track, at fetes, etc., sufficient detail was included, so that, in appearance, it should be fairly representative of its prototype. Such drawings, and sketches as were necessary, were made as the work progressed, and as information concerning details of the full-size engine came to hand.

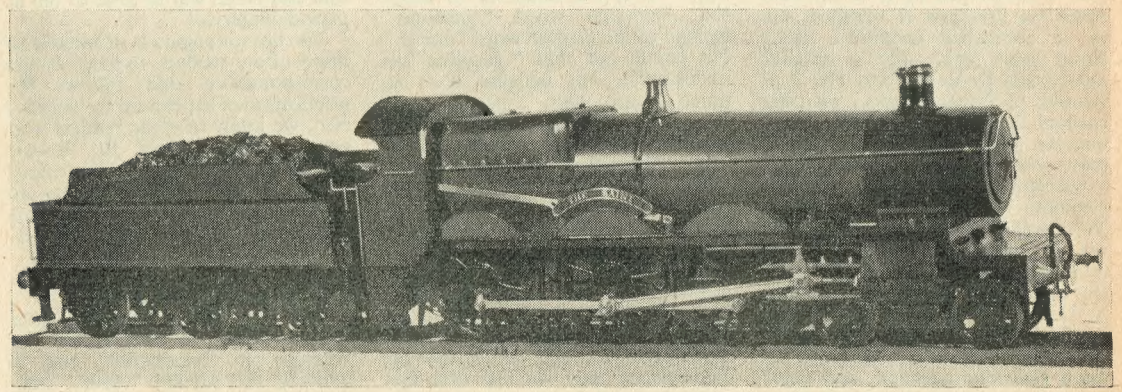
The main frames, ⅛ in. thick, terminate, as on the prototype, just ahead of the leading coupled wheels. Extension frames are bolted inside them at this point, and extend forward to the front buffer-beam. Due to their small cross-section, and the fact that the exhaust passages pass through them, these are of $\frac{3}{16}$-in. gauge-steel.

The 5 in. diameter driving wheels are mounted on $\frac{9}{16}$-in. axles, which run in plain axleboxes. These are fitted with two coil springs, ⅜ in. diameter, and are lubricated by oil-cups, and pipes, two of which are between the frames and two inside the cab.

All the motion-work is of steel. Coupling- and connecting-rods were cut from the solid, most of the metal being removed by means of a ¾-in. spiral end-mill running between lathe centres. A simple jig was made to hold the rods upon the cross-slide, and also to enable them to be raised into cut. Flutes were cut with a Woodruff cutter, using the same jig. The built-up crossheads and guide-bar brackets are also of steel, the latter being carved to shape from a piece of ⅝-in. × 2-in. bar 5 in. long.

The bogie is of the G.W.R. bar-frame type, with equalisers and inverted springs. Side-control springs are fitted, and the weight of the locomotive is taken by two spherical pads, nesting in cups, which are free to slide upon the bogie bearing-plate.

The slide-valve cylinders were cast locally from a simple pattern, and these, together with the commercial wheels and hornblocks were the



Mr. P. F. Arnold's 3½-in. gauge "Saint"—a "first attempt" at model locomotive building

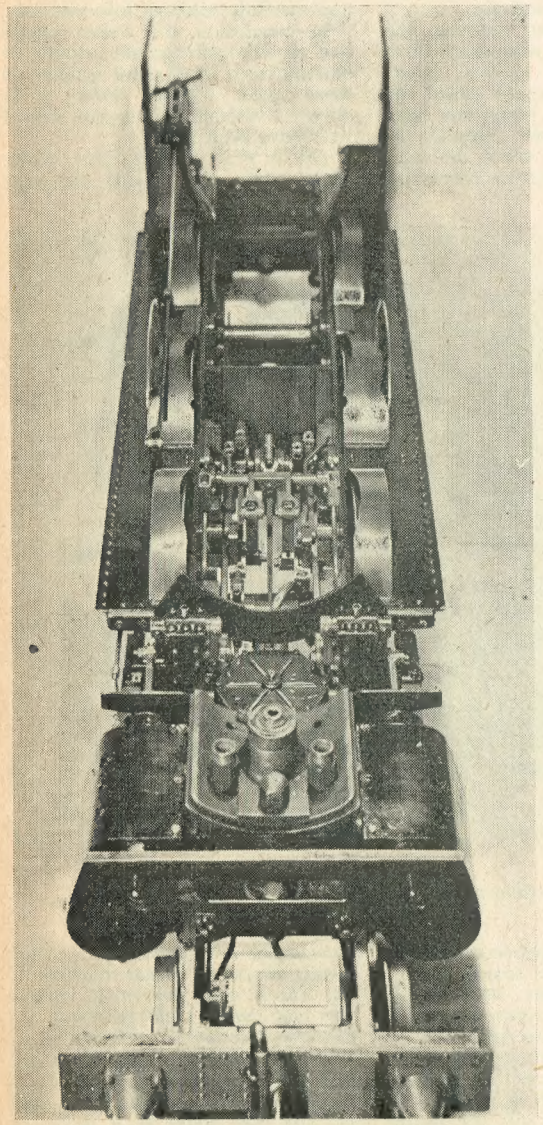
only castings used. They are camouflaged externally to represent the piston-valve type of the full-size locomotive, and are 1⅛-in. bore by 1⅞ in. stroke. Steam ports are ¾ in. × 0.112 in.; exhaust, ¾ in. × 9 32 in.; the valve travel being 0.45 in and the lap 0.112 in. The sniffing-valves are on the steamchests and the drain cocks are operated by rods and cranks from the cab.

Dural is used for the pistons, and an "L.B.S.C." mechanical oil-pump takes care of the lubrication.

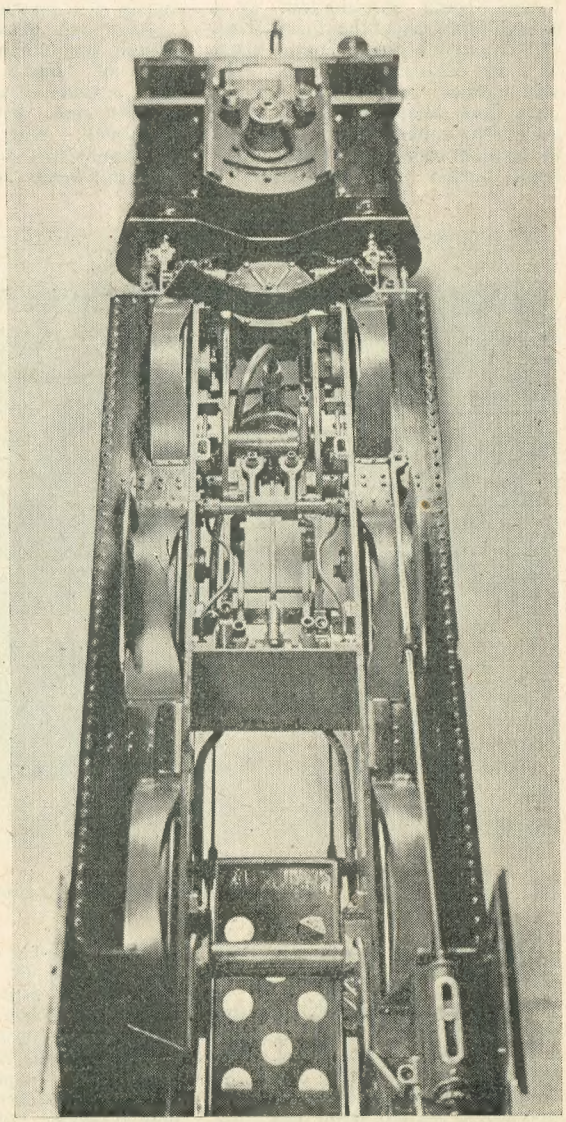
The arrangement of the Stephenson valve-gear is as on the prototype, but the links are lengthened slightly to accommodate the longer-than-scale valve travel.

The boiler has a tapered barrel and firebox, and, except for the backhead, is of 13-g. copper. It is of riveted and soldered construction, the inner firebox, and the firebox end of tubes, however, being silver-soldered. The taper barrel has an internal butt-strip with two rows of rivets each side of the seam. There are twelve $\frac{7}{16}$ in. diameter tubes and two ¾ in. diameter superheater flues. Firebox stays, both roof and sides are $\frac{3}{16}$-in. copper at 1 in. centres, and are nutted inside and headed outside. There are two $\frac{3}{16}$-in. hollow longitudinal stays, and one of these supplies the blower.

The main steam-pipe, through which the regulator-rod passes, extends the full length of the boiler, and is permanently built in. Steam is collected from the two forward corners of the firebox, and conveyed by this pipe to the disc-



Note the slides and clamp-bolt for smokebox, built into saddle



General view of chassis, showing link motion

type regulator situated in the smokebox.

Detachable Smokebox

It was decided in the beginning that, having no outside steam-pipes to contend with, the smokebox should be detachable. This was easily arranged. By slackening one nut only, inside the smokebox, it can be completely removed, thus allowing easy access to tubes, regulator, blast-pipe and steam-connections. With a small smokebox, this has proved a great asset.

Working pressure is 75 lb., the twin safety-valves and top-feed deliveries being incorporated in a flanged fitting under the characteristic G.W.R. casing turned from a piece of 2 in. diameter brass bar. The side casings were formed in one piece from sheet copper, which was then silver-soldered into a slot cut in the main casing, the inside portion being turned away afterwards.

diameter 10 t.p.i., and both it, and its nut were cut in the lathe.

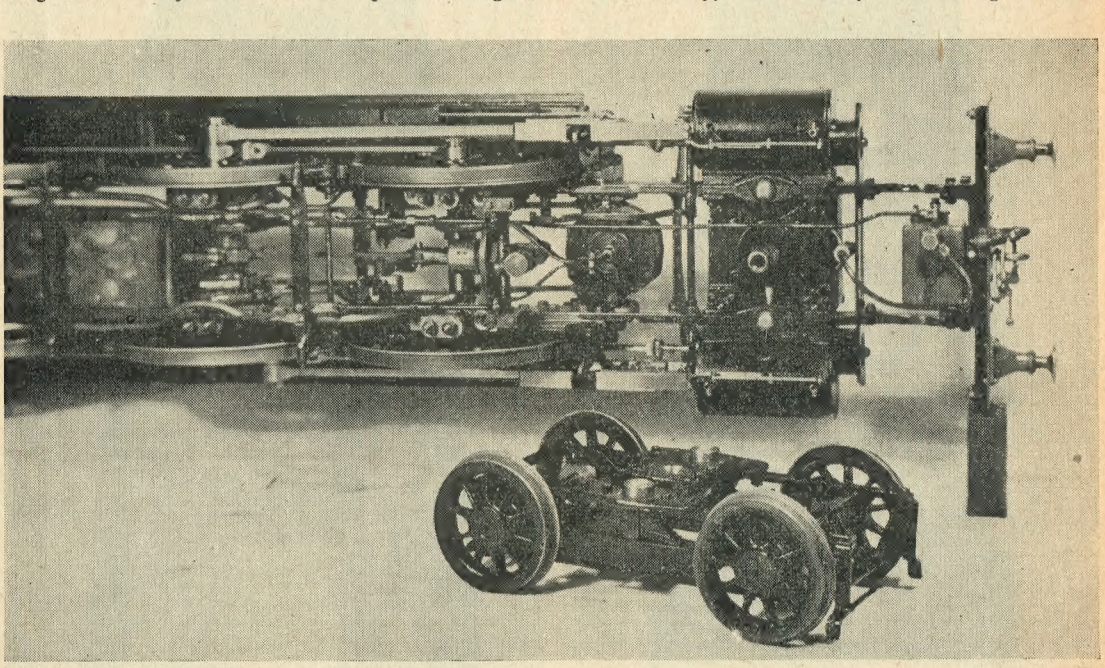
Tender Details

The tender is quite straightforward. It contains a double acting hand-pump which is operated by removing the domed water pick-up cover. The axleboxes, horn-blocks and leaf springs are built-up, but the latter, being too stiff to work, small coil springs are fitted under the heads of the hangers and are hidden by the valance. Since rivets with scale-size heads were unobtainable, such rivets as are visible, are dummy, and were formed by means of a punch and die.

After two seasons' running, the engine, and tender were given three coats of " Bonds " G.W.R. green, with a trace of varnish added for the last coat. No lining has been attempted. With the exception of the nameplates, for which the faceplate of a larger lathe was necessary, beading, and produce the correct radius at each end, at one setting. This was used in a small cutter spindle on the cross-slide of the larger lathe referred to, with the plate blanks clamped at a suitable radius upon the faceplate. A worm, meshing with the large back-gear wheel, provided the necessary rotary motion. Cuts were taken at settings each side of the central ones and thus formed the other half of the beading. Surplus metal was then removed and the edges trimmed to shape. The letters were filed from 20-gauge brass, using a large lens for viewing the work as it progressed, and carefully soldered into position.

In conclusion, the writer would like to acknowledge the assistance derived from locomotive articles in these pages, without which, it is doubtful whether this engine would ever have been built.

(As a first attempt, this engine must surely rank among the most outstanding ever made. All visible details are pure " Great Western "; the wheels have flanges of correct size and shape, while the tyres are properly represented. There is even a cut-off indicator on the reversing-screw, as seen in the " general view " photograph of the chassis. Yet, with all this, the engine is a first-class worker and gives no trouble whatever when in steam.—ED., " M.E.").



Underside view showing extension frames and bogie bearing-pads

The feed is by axle pump and hand pump, the clacks being between the frames. The boiler was tested to 250 lb. hydraulic and 100 lb. steam, and finally lagged with asbestos cloth and 22-g. sheet brass. The whistle is fixed vertically under the footplate, the top of it being accommodated in the box upon which the screw-reverser is mounted.

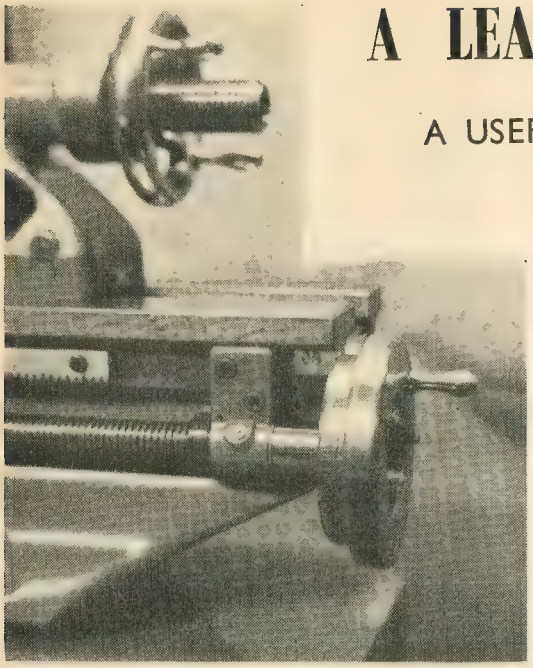
The reverser screw is 7/32 in. all the machining was accomplished with the aid of a treadle-driven, 2-in. centre pre-war lathe, fitted with an extra-long cross-slide, and a motor-driven sensitive drill.

Regarding the construction of the nameplates. A special fly-cutter was made, of such form and diameter, that it would mill out the centre recessed portion of the plates, form the inner half of the semi-circular

A LEADSCREW HANDWHEEL

A USEFUL FITTING, INCORPORATING AN ADJUSTABLE INDEX

By N. Kettle



The handwheel in position, showing the easily accessible locking-lever (in the locked position)

I HAD often considered getting a leadscrew handwheel and pointer for my M.L.7, but for some reason or other had always put off buying one for something I considered at the time to be more essential. In fact, I had managed pretty well without one in the past but when I had a series of slots to mill out to a definite depth, I realised that it could be put off no longer. The problem then was whether to buy one or to make one, and it was decided in favour of the latter course provided one could be designed with an adjustable index. The main point of difficulty encountered during the designing was the method of lock and release of the index dial. The leadscrew of the M.L.7 is very close to the lathe bed and there was not considered sufficient room to put a screw lock on the index which could be manipulated easily and without falling back on the use of a spanner or tommy-bar.

Eventually a method of locking was devised which worked from the outside of the handwheel and could actually be operated without taking the hand off the handle. The accompanying drawings were completed and a start was made.

As will be seen from the drawing the index is a running fit on a shoulder turned on the handwheel itself, and as I considered it easier to turn a diameter to fit a bore than vice versa, I started on the index itself.

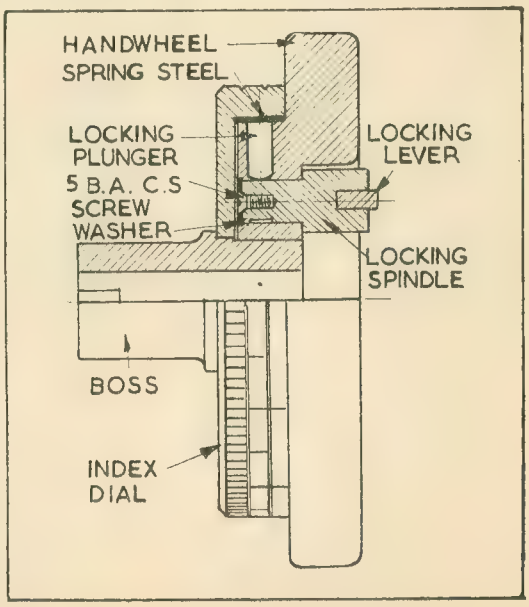
A piece of mild-steel bar was chucked and one side faced off. It was then reversed in the chuck, centred, drilled and faced to the correct thickness, and finally bored out to the sizes shown in the drawings. The partly finished index was mounted on a stub mandrel with the open bore facing the chuck, and the outside diameter turned to size with a series of light cuts. The grooves were cut with a "vee" tool and the edge of the dial chamfered. These grooves form part of the indexing and should only be deep enough to be seen easily.

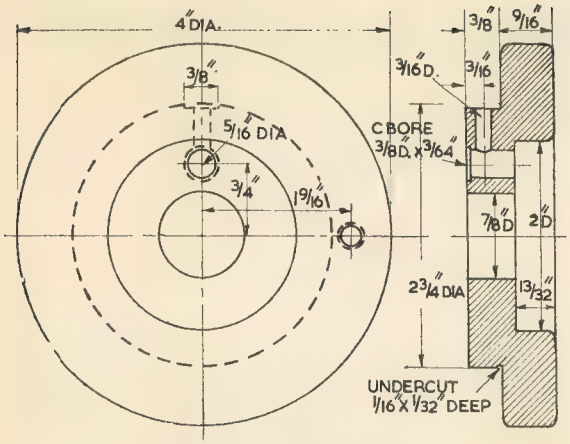
This was considered to be the correct time to do the indexing, as the dial was suitably mounted and was running true. The change-wheels were, therefore, selected to give the correct number i.e., 125—divisions.

The method of indexing from the lathe mandrel using lathe change-wheels has been described many times in the past and there is little point in going into it again in any detail.

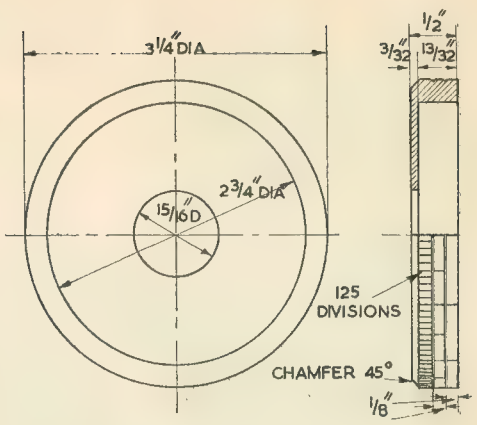
The divisions are obtained using a 50-T. wheel as the driver on the tumbler reverse meshing with a 30-T. wheel on the first stud. Along with the 30-T. wheel on this stud is the 75-T. wheel from which divisions are taken by the detent. The 30-T. wheel (and, therefore, the 75-T. wheel also) must turn $1\frac{20}{30}$ revolutions to mesh with all 50 teeth of the driving wheel. Therefore, for 1 rev. of the 50-T. wheel (and thus 1 rev. of the index) the 75-T. wheel will turn through $1\frac{20}{30} \times 75$ teeth. This is $\frac{50}{30} \times \frac{75}{1} = 125$ teeth. If, therefore, the detent is engaged with every tooth of the 75-T. wheel and the slack taken by pulling gently on the chuck *the same way each time*, we shall eventually split the dial up into 125 equal divisions.

The graduations themselves were made with a "vee" tool set sideways in the toolpost at centre height. The units were taken to the first groove, the fives to the second one





Handwheel (1 *off, mild-steel*)



Index dial (1 *off, mild-steel*)

and the tens straight across the dial. No snags at all were encountered indexing the dial by this method and the whole division, including setting up the change-wheels and detent took little over 30 minutes to complete.

The dial was then removed from the mandrel and the numbers stamped on it in exactly the same way as described in THE MODEL ENGINEER of March 27th, 1952, taking care that the numbers went the right way round and were the right way up.

When the dial was completely numbered, it was put back on the mandrel and the burrs removed with a fine Swiss file, followed by fine emery cloth.

The index was now completely finished and attention could be turned to the handwheel itself.

This was turned from a solid piece of mild-steel of a suitable size, starting by centring, drilling and boring out to $\frac{7}{8}$ in. It was faced exactly as for the dial, finishing off at a slightly higher speed to give a good finish.

Next, the shoulder was carefully turned until the index itself was a good running fit on it and was undercut as shown on the drawings, using a fine parting-tool. The work was finally reversed in the chuck, faced off and bored out to the correct size. The edges of the rim (inside and outside) were carefully rounded off and polished.

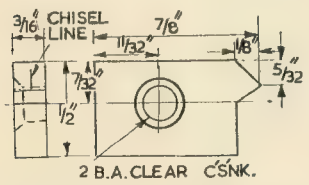
A hole was drilled and reamed to $\frac{5}{16}$ in. to take the locking spindle, the inside edge of this being opened up to $\frac{3}{8}$ in. to take a retaining washer. Next, the $\frac{3}{16}$-in. hole was drilled from the shoulder to meet this hole squarely.

The handwheel was replaced in the chuck, and, using a parting tool on its side and at centre height, the shallow depression over this hole was cut using the lathe carriage as a shaper, the tool running off into the undercut. This depression takes a piece of spring steel (I used part of an old alarm clock), and prevents the locking plunger marking the inside of the index bore when the lock is brought into play.

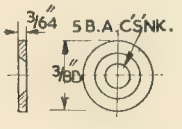
The locking spindle was next to be tackled and was a straightforward piece of turning from a piece of $\frac{1}{2}$ in. bright mild-steel. The eccentric was turned by putting a piece of thin packing under one jaw of the 3-jaw chuck to throw the spindle itself out of true. The eccentric should be exactly under the $\frac{3}{16}$-in. plunger hole, so that when the spindle is turned one way or the other the locking plunger is moved very slightly up or down.

Four or five thou. movement here is ample and more is not necessary. The washer was then fitted, making sure that the 5 B.A. c/s screw went completely home. It was found necessary to open up the tapped hole slightly here, as the washer itself allowed part of the c/s head of the screw to go straight through it, making it impossible to screw the washer up tightly. This was easily done with a fine centre drill. The spindle was now fitted to the handwheel and the retaining washer screwed into place and tested for freedom of movement. This proved to be quite satisfactory and the spindle was removed, and the eccentric end case-hardened.

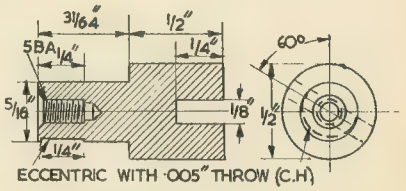
The locking lever was made next from $\frac{1}{8}$ in. bright mild-steel flat, and a slot cut in the locking spindle at such an angle (approx. 60 deg.) that when the eccentric was pushing the locking plunger in the outward position the locking lever would almost touch the inside rim of the handwheel. Reference to the drawing will make this point quite clear. The locking lever was pressed into the slot and proved to be so tight a fit that no further pegging was required.



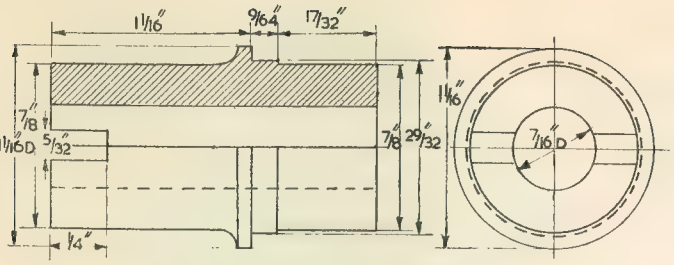
Painter (1*off*, $\frac{3}{16}$ *in. bright mild-steel flat*)



Retaining washer (1 *off, mild-steel*)

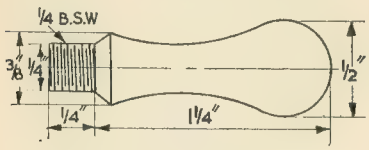


Locking spindle (1 *off, mild-steel*)



Handwheel boss (1 *off, mild-steel*)

The locking plunger was then cut from a piece of $\frac{3}{16}$ in. bright mild-steel, the exact length being determined by trial and error. When the correct length had been found, the dial was locked when the lever was almost to the inside rim and was released when the lever was moved centrally. The locking plunger was finally removed and case-hardened. When the lock was released, the dial moved smoothly with no trace of wobble and could be locked in any position without distortion. The hole for the handle was drilled



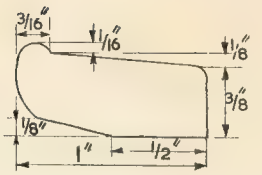
Handle (1 *off, mild-steel*)

and tapped $\frac{1}{4}$ in. B.S.W. taking care not to go straight through the handwheel rim.

The next job to be tackled was the handwheel boss. This was turned out of $1\frac{1}{16}$ in. bright mild-steel, first of all centring, drilling and reaming to $\frac{7}{16}$ in.

The two registers were turned true with this bore. The $\frac{7}{8}$ in. one was a force fit into the handwheel itself and the 29/32 in. shoulder prevented the handwheel trapping the index when it was forced home. The work was then reversed in the chuck and the shank of the boss turned to size. The slot for the peg in the leadscrew was cut on the shaper so that a piece of 5/32-in. silver-steel would just slide in, taking great care that the slot was exactly central. The sharp edges of the slot at the end of the boss were removed with a fine file, to prevent the end of the boss cutting into the leadscrew bush housing bracket when the handwheel was fitted to the leadscrew. All that remained now was to assemble the handwheel and dial on the boss.

Before this was done the "innards" were well oiled and the dial tested once more. The boss was then forced into the handwheel in the vice, using an old ball-race to prevent the locking lever fouling the jaws of the vice. The dial was released and tested for freedom of movement with each tightening of the vice jaws. When the boss was pressed completely home, the dial still moved freely but was locked immovably when the lock was applied. Attention was next turned to the handle, which was a simple piece of turning, the $\frac{1}{4}$-in. B.S.W. thread was cut first and the handle roughed out and then parted off. This was then mounted in a screwed mandrel and finish-turned and polished in this way. The completed handwheel was finally fitted to the leadscrew and the existing $\frac{7}{16}$ in. B.S.F. nut turned down so as not to foul the locking lever. When fitted, the face of the index



Locking lever (1 *off,* $\frac{1}{8}$ *in. bright mild-steel flat*)

was a bare 1/64 in. from the end of the lathe bed.

The pointer was simply filed out of $\frac{3}{16}$ in. bright mild-steel flat and was held in position by a 2-B.A. countersunk screw in the existing tapped hole in the lathe bed itself. The line on the pointer was made with a light tap on a small freshly sharpened chisel and gently filed to remove the burrs.

The lathe was then run with the leadscrew on the finest feed and the handwheel, very gratifyingly, ran dead true.

Since its completion, the handwheel has been used many times and has proved very easy to reset and extremely accurate in use, and has been well worth the trouble and time taken to design and construct it.

I would like, in closing, to express my thanks to Mr. L. Gordon, a fellow member of the Ashton-under-Lyne Model Engineering Society for producing the photograph which has helped to illustrate this article.

For the BOOKSHELF

Passe-Partout for School and Home, by Frederick T. Day. (London: Newnes Educational Publishing Co. Ltd.). 120 pages, $4\frac{3}{4}$ in. by $7\frac{1}{4}$ in. Price 8s. 6d. net.

This is a thoroughly practical handbook giving clear instructions in the use of passe-partout binding for framing, model making and all kinds of decorative work. There are eight chapters which, after a general introduction to the subject, are carefully graded from the simplest instructions, suitable for the youngest beginners, to much more elaborate advice for advanced workers who may wish to apply passe-partout to the decoration of the rooms in the home. In each chapter the illustrations show clearly what can be achieved at each stage of the craft, and although the book is primarily intended for use in the handicrafts classroom, it can hardly fail to attract a large number of more general readers.

British Cars, 1953. (Birmingham, P.-C. Publications. 56 pages, size $9\frac{1}{2}$ in. by 7 in. 88 photographs, 8 pages of specifications. Price 6s.

It is stated that the object of this book is to provide a permanent photographic record of British cars produced during the year. Within that definition, this work by Mr. Peter Chambers is a success, and it is well produced, both as to the concise text matter and specifications, and in respect of the excellent monochrome illustrations. It is a pity, however, that it should have become available only at a time when many new and different models are already in production and on the roads, after having been shown to the public at the last Motor Show.

Glass-fibre Laminating Techniques

Methods of Production in a New Industry

Glass-fibre mat is cut to pattern before laying-on

IN a previous article (THE MODEL ENGINEER, February 18th, 1954), the general properties of glass-fibre plastic laminates were considered. It is the intention here to deal briefly with the subject of certain production methods which are by now fairly well established. Briefly it must be, because there are almost infinite variations of production methods as applied to different subjects.

Even in full-scale industry, a manufacturer who is entering the industry for the first time is faced with many special problems and is almost compelled to seek expert advice from the glass-fibre and plastics manufacturers who not unnaturally, know more about their somewhat complex materials than do most other people.

Probably today the best examples of typical production methods lie in the small-boat field, and many of the principles apply equally well to other fields such as that of car-body production, the manufacture of containers and utensils of various kinds, household and decorative articles, models, etc.

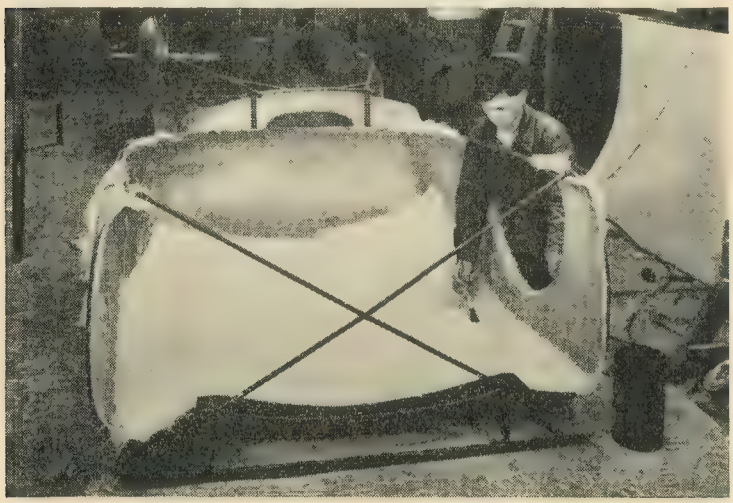
The first stage in construction—after design, drawing and development—involves, as usual, the making of a master pattern. In the case of a boat hull or car body, this would be built in wood, metal, plaster, wax, or some combination of those materials. This pattern would be built to all proper dimensions and highly finished, these requirements being dictated by the fact that a female mould would be the next stage in production and that the surface of the pattern would automatically be reproduced faithfully in the production shells. A mould is necessary because professional manufacturers wish to produce in quantity, but in amateur work the actual finished shell might be made direct from a clay or balsa mock-up.

Cases have been known in which an existing production job—a timber-built dinghy, a pressed-steel or metal-panelled car body—has been used as the pattern and this method might well be of value to the model-maker, at least with the object of avoiding unnecessary labour when carrying out initial experimental work.

The pattern is coated with a brushed or sprayed separator (probably polyvinyl acetate) or a sheet-form separator such as Cellophane, and then pure or pigmented resin of fast-setting type is brush or spray applied. This layer, of course, forms the inside or working surface of the female mould, and may be about $\frac{1}{16}$ in. thick in the case of a full-scale job.

The next stage is to apply glass-fibre mat, and/or glass-cloth. This is one instance where the choice of materials is dependent upon the particular purpose, and glass-cloth, with its close weave but greater expense, would give higher strength than chopped-strand mat, whilst diamond-form mat would be used if uni-directional strength were needed.

Thickness would be built up according to requirements, but in full-scale work, half a dozen layers, each impregnated with resin, would probably be sufficient. However,



Successive layers of glass-fibre mat are laid up in the mould and impregnated with polyester resin

thickness is not critical in the case of the mould.

This general process, called the "wet lay-up," is nominally a no-pressure rather than a low-pressure technique, but the layers might be squeegeed to remove bubbles. Cold curing might be employed—that is to say a type of resin which is self-setting might be used—but it is not unusual for heat to be applied either by infra-red lamps, or by passing current through electrical elements which have been embedded in the laminations during the making-up process.

When the shell is cured, it is made completely rigid by the addition of a timber or metal frame, and it is then set-up ready for production.

Manufacture of the shells follows very closely that of the method used in making the mould. It is possible that certain additional parts of a final structure—e.g., metal brackets, strengthening fillets, hinges, etc.—might be bonded into the shell as it was in process of formation.

Bakelite Ltd., who are specialists in the polyester field, as well as in the manufacture of other plastics, say that if cold curing is used, it is advisable, wherever possible, to post-stove the structure to make sure of maximum strength and chemical resistance. It may be advisable to build up an artificial viscosity in the resin by incorporating china clay or other fillers, thereby producing a material too viscous to run out of the reinforcement, but one from which free resin may be drawn by capillary action around the glass fibres.

A very wide range of mechanical properties is at the disposal of the user of polyester resin-bonded glass-fibre laminates, depending upon the type of polyester resin used, the type of glass-fibre reinforcement, and the conditions—e.g. resin pick-up, curing time and temperature and moulding pressure.

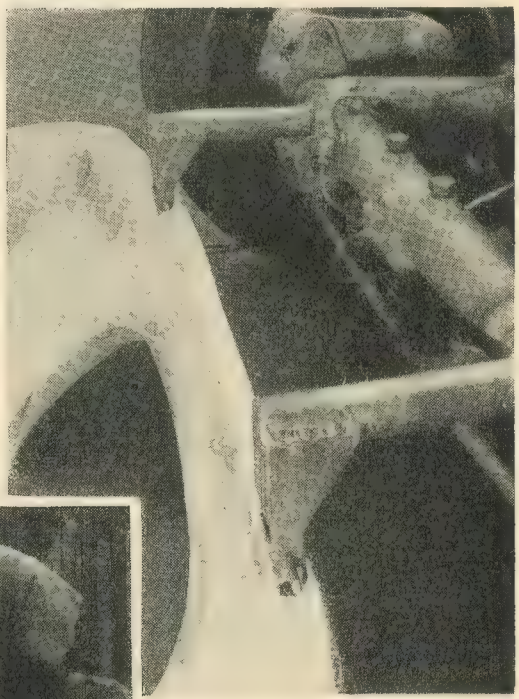
Compression moulding is, of course, also possible, but the high pressures associated with work in more normal materials are not called for. The matched-mould process uses tools fabricated from steel, light alloy, reinforced plastics, or any other hard material capable of withstanding the temperatures chosen for the operation. For short runs, plaster has been found satisfactory. In all cases the surface of the mould must be treated with a separating agent.

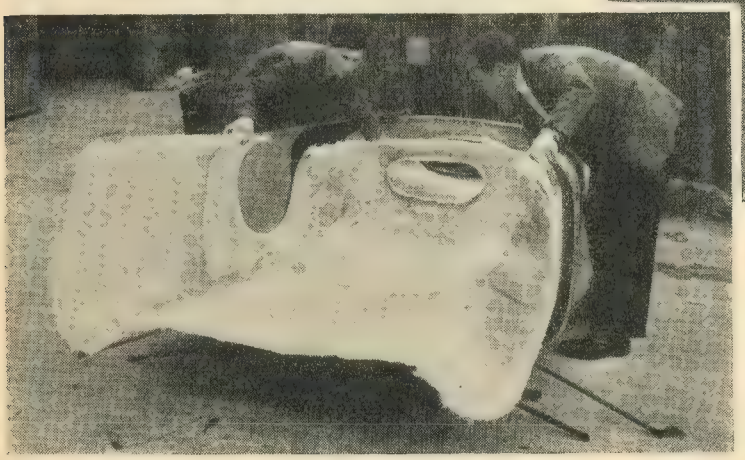
Briefly, the process consists of placing the reinforcement in position, pouring over it a measured quantity of catalysed resin and closing the mould slowly to allow the moving resin to displace trapped air. Flash-type moulds are preferable unless the shape is extremely simple with little danger of trapped air.

These resins may be cast without fillers, incidentally. Moulds may be any available material including polythene, glass, metals, or resin which has already been cast. Articles may be embedded in unfilled resin for decorative purposes, or may be "potted" for protective purposes. The high flexibility of some of the types make them suitable for embedding very delicate small mechanisms to protect them from shock or vibration.

Sometimes a process known as dough moulding is carried out. Chopped strand glass-fibre, and filler resin are mixed thoroughly, and the mix is then moulded in closed moulds. Pressures up to 2,000 p.s.i. are necessary to cause sufficient flow when making intricate shapes, but simple press tools, beating blocks, etc., can be made at low pressures, and it would seem a method worth exploring.

There are a number of ways of making laminations with inner and outer surfaces highly finished. Sometimes air is blown into a rubber bag, to force the material into the contours of a mould, assuming it to be of a fairly simple shape. There is also the vacuum impregnation method, whereby the glass-fibre is laid-up dry on a male mould, a female mould is placed in position and the resin is drawn up through a matrix by means of a vacuum. Using this method, a final moulding is obtained with two good surfaces, but pigmented resin cannot be used, as the pigments will settle out.





Hinge-brackets are sometimes bonded into the structure

When the laying-up in the mould is completed, the moulding is left for twenty-four hours so that the resin may harden. The shell is then removed from the mould

Photographs taken at the works of the N.E. Coast Yacht Building & Engineering Co. Ltd., are by courtesy of Bakelite Ltd.

A Drilling Problem

By "Duplex"

RECENTLY, when fitting a raising screw to the table of a machine, a 1 in. diameter hole had to be drilled in the machine base to fit the register on the screw guide and also to form a passage for the screw spindle.

As long as this hole afforded accurate location, any minor irregularities of outline mattered little, for the hole itself was covered by the screw guide and was out of sight.

It was decided to remove the surplus metal by drilling a circle of holes and then cutting out the core. However, a difficulty cropped up at the outset, as the distance from the centre-line of the hole to the edge of the work was 4 in., and the capacity of the larger of the workshop drilling machines was only 3½ in. Doing the job with a hand-drill seemed out of the question, as the cast-iron base was nearly ½ in. thick and a deep web projected on the underside.

No electric hand-drill was available, but even with this tool there might have been some difficulty in drilling through such irregularly shaped material. Moreover, it is obviously important to drill exactly vertically, if the maximum amount of metal is to be removed without the drill running out of line and jamming in the holes already drilled.

Clearly, the way out was to do the work in the ordinary, power-driven drilling machine after alterations had been made to increase the depth of throat.

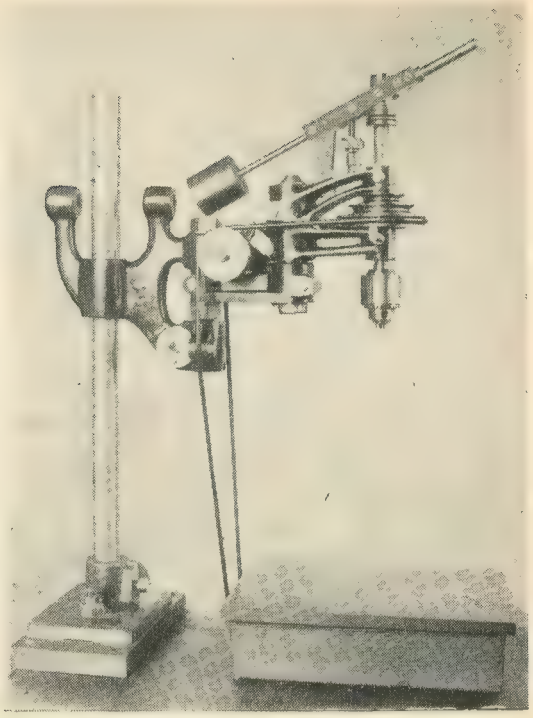


Fig. 2. The improvised set-up of two combined drilling machines

An Improvised Set-up

The problem was solved by combining two drilling machines in the way illustrated in Fig. 2, but here the long feed handle has been temporarily removed. That very versatile machine, the "Model Engineer" drilling machine, was dismantled; the headstock was then clamped to a short length of 1 in. diameter rod, and to the lower end of this the machine's table bracket was also clamped. The column and headstock of a discarded drilling machine, when mounted on their base casting, were next fixed to the bench, and the table bracket of the first machine was secured to the headstock of the second by means of a ½ in. diameter Whitworth bolt. The resulting set-up was found to be surprisingly rigid and afforded a throat depth of 6 in., measured from the centre of the spindle to the belt-line.

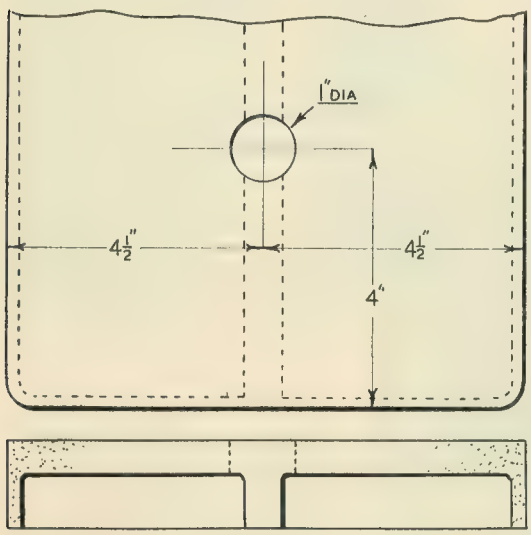


Fig. 1. Showing the work-piece and the position of the drill hole required

The belt passed through the existing slot cut in the bench top, so that the drive could be taken from the electric motor already mounted on the underside of the bench. To allow for the variation of belt length, when the headstock assembly was raised or lowered on the column to accommodate drills of different lengths, a round, plastic belt, having the necessary elasticity, was fitted.

These plastic belts, obtainable from an advertiser in this journal, have been found to serve well for light, high-speed drives and, in addition, they have good gripping qualities when running on properly designed V-pulleys.

A surface-plate, resting evenly on the bench, formed the new drilling table, and on this a piece of wood was placed to raise the work and protect the surface of the table.

Marking-out the Work

The object is, of course, to remove as much surplus metal as possible by machining, in order to lessen the subsequent work of hand-filing when cutting out the core and finishing

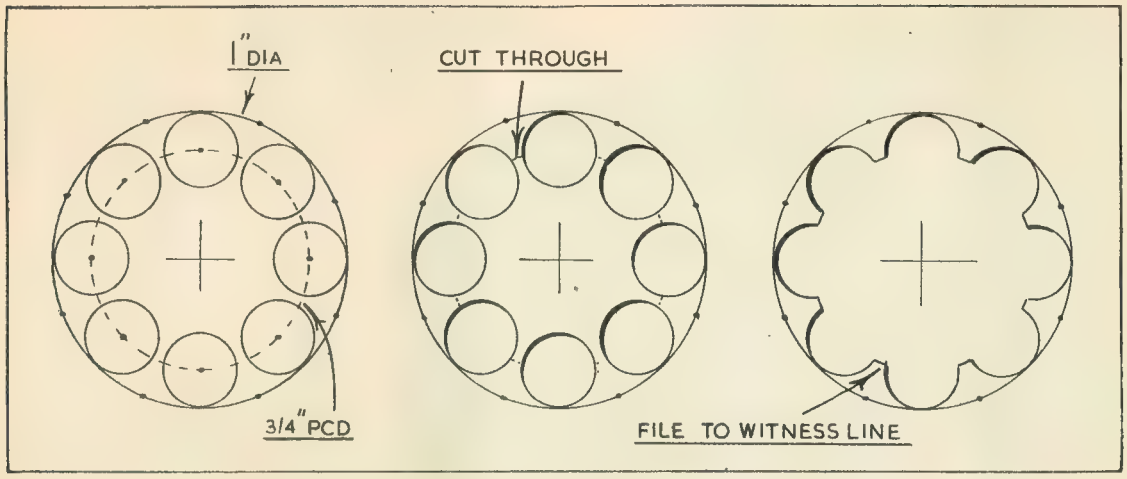


Fig. 3. Stages in drilling the work and removing the central core

the hole to size. As shown in Fig. 3, a witness line, consisting of a circle 1 in. in diameter, is first scribed from the marked-out centre, and this circle is lightly punch-marked in eight or more places in order to preserve the witness line from obliteration during the drilling operation.

If a circle of eight $\frac{1}{4}$ in. diameter holes is drilled on a pitch circle $\frac{3}{4}$ in. in diameter, the peripheries of these holes will just meet the witness circle and, at the same time, a web, approximately 40 thou. in. in width, will be left between adjacent holes. This figure is arrived at by taking the length of the circumference of a circle $\frac{3}{4}$ in. in diameter as 2.35 in., and subtracting from this the 2 in. of circumference occupied by the eight $\frac{1}{4}$ in. diameter holes; this leaves 0.35 in. to be distributed equally between the eight webs.

The Drilling Operation

After the centres of the eight holes have been marked with a centre punch, a centre-drill is run in to form countersinks $\frac{1}{4}$ in. in diameter. Next, a $\frac{1}{8}$ in. diameter drill is put right through the work in all eight places, and this is followed by enlarging the holes, in turn, with a $\frac{3}{16}$ in. and a $\frac{1}{4}$ in. drill. To speed up the drilling, the machine was set to run at some 1,000 r.p.m., and for this work it is best to use high-speed steel drills, as these can be run at twice the speed of ordinary carbon-steel drills, and they have less tendency to become worn at the sides of the point when drilling cast-iron.

Once a drill has become worn in this, way it will jam in the hole after a certain depth of drilling has been reached, and much of the point will have to be ground away to restore the drill to its nominal diameter. After all eight holes have been drilled right through the work, the intervening webs are filed down with a round file until the holes meet. The central web projecting from the under side of the casting, is apt to interfere with the filing, and it was found that an Abrafile blade mounted in a coping saw frame enabled the remaining metal to be more easily cut through. Towards the finish, the central core was, without difficulty, broken off by tapping it lightly from side to side.

Finishing the Hole to Size

The irregularities formed by the remaining portions of the webs are next filed down with a round file, and filing is continued until the circle of dots on the witness line is reached. All that now remains to be done is to file down any high spots so that the register on the mating part can fit into place in the base casting.

It will be clear that forming a 1 in. diameter hole in this way in thick metal takes time, but on the other hand, one has the satisfaction of doing the job with a limited tool equipment and without having to rely on outside help.

"UNICORN" ENGINE CASTINGS

Mr. W. H. Haselgrove, 1, Queensway, Petts Wood, Kent, has submitted to us samples of castings for the "Unicorn" mill engine described in the series "More Utility Steam Engines." These castings have been produced in close collaboration with the designer, and are correct in all essentials; the quality of the metal, and accuracy of moulding, are also of the usual Haselgrove standard. They include the bedplate and flywheel in cast-iron, and cylinder, covers, crosshead, bearing pedestals, crankhead, eccentric strap, and cylinder bracket, all in medium hard bronze. Blueprints for this engine can be obtained from this office, price 3s. 6d. each.

Mr. Haselgrove has also sent us castings for the "1831" water-cooled twin 30 c.c. petrol engine, which was described during the war as the power unit for an i.c. engined locomotive, but has been found in addition to be suitable for other purposes, and has already attained some popularity as a powerful, flexible and relatively quiet marine engine. The main structural castings, including the monobloc body, sump, timing case, etc., are in aluminium alloy, instead of the originally specified gunmetal, in order to save weight when used for marine work. Blueprints for this engine also are available, in two sheets, price 2s. 9d. per sheet. Mr. Haselgrove supplies castings for several other i.c. engines and locomotives to "M.E." designs.

Jubilee of Perfection

THE BIRTH OF THE ROLLS-ROYCE

by C. W. Morton

One of the very early 10 h.p. twin-cylinder Rolls-Royce cars alongside a modern Silver Wraith. The veteran took part in a recent historic motoring event, and is in perfect condition

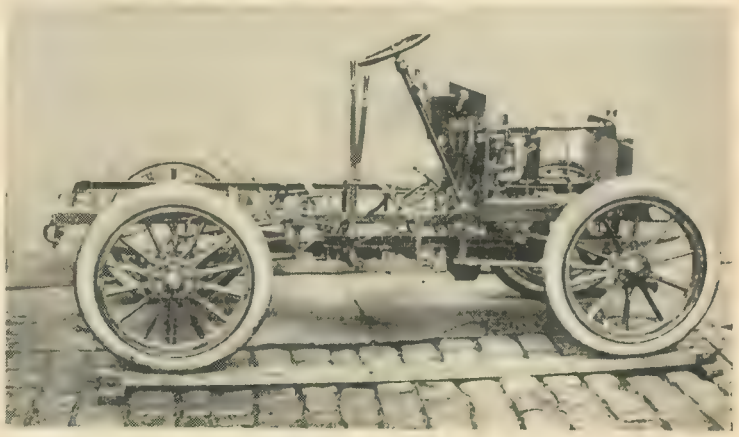
ON April 1st, 1954, exactly 50 years will have elapsed since the first Royce car emerged from the entrance of Royce Ltd., engineers, of Cooke Street, Manchester. It was driven by Henry Royce himself, and his passenger on this historic first test run was his young apprentice, Eric Platford (in later years known as "E.P." to everyone of consequence in Rolls-Royce).

This little 10 h.p., 2-cylinder experimental car had been largely hand made, much of it by Royce himself. The orders for the high-quality electric cranes and dynamos, which had formed the "bread-and-butter" lines of the company, had begun to decline owing to cut-throat competition from Germany and U.S.A. Henry Royce refused to allow his name to be associated with a cheapened product of lower quality, and instead turned his attentions to the motor-car, which he was convinced held a wonderful future. His enthusiasm was not entirely shared by his partner A. E. Claremont who, whilst the first three experimental cars were under construction, would ask: "How are the 2-guineas-an-ounce jobs getting on?" . . . !

Construction of the three cars was commenced in the autumn of 1903, and, as stated above, the first one had its initial road test on April 1st, 1904. This date was suppressed for many years, and given as March 31st, because the motor-car in 1904 was the favourite butt of music hall comedians, who likened the passing of a motor-car to an avalanche of tea trays.! Royce need not have worried however, as this first car, queer as it may look today, was the true forbear of the long line of Rolls-Royce cars, the name of which was destined to become synonymous with perfection in engineering, and this first little 10 h.p. 2-cylinder car was possessed of a refinement and functional perfection without equal in any other car of its period.

This car was used personally by Royce for many years, then it became the works mail car, plying between Nightingale Road and Derby L.M.S. Station. It was finally pensioned off in 1923, still running well.

The second experimental car, of the same type as the first, was taken by Royce's partner A. E. Claremont, on the condition that it should be used as a "guinea-pig" for many new ideas. This somewhat affected its reliability, and although Claremont was very patient with Royce and his experiments he could not endure the inevitable questions fired at him by passengers, and he fixed a notice to the dashboard which said: "If this car breaks down, don't ask a lot of silly questions." He took to being followed by a hansom cab, when, if a breakdown did occur, he would continue the journey in the cab, and telegraph the works to collect the "guinea-pig."



The very first Royce car chassis, in an almost completed state. Its engineering rectitude stands out a mile

The third experimental car was taken by Henry Edmunds, a newly appointed director of Royce Ltd. Edmunds was an experienced motorist and an influential figure in motoring circles. He immediately realised the merits of the little car, and after much difficulty and delicate negotiation, arranged for The Hon. C. S. Rolls (then importing and selling Continental cars in London)

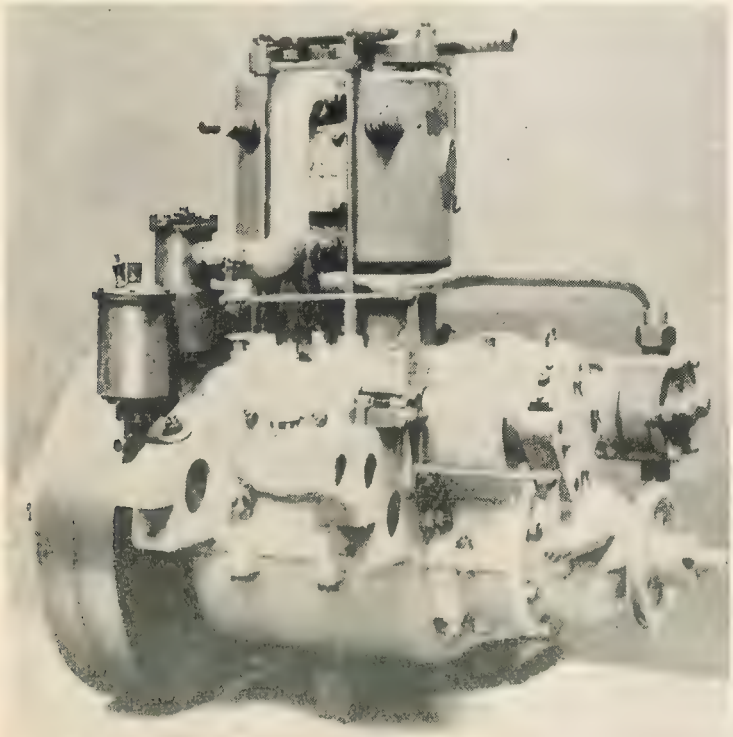
to come to Manchester to try the little Royce and to meet its designer. Rolls was captivated by the car, and between himself and Royce there immediately sprang up a friendship born of mutual interests and respect. The eventual outcome was the merging of the Rolls and Royce companies. It also secured for the Rolls-Royce company the services of Claude Johnson (until then general manager of C. S. Rolls & Co.), whose brilliant direction of the commercial side of Rolls-Royce Ltd. has had comparatively little publicity.

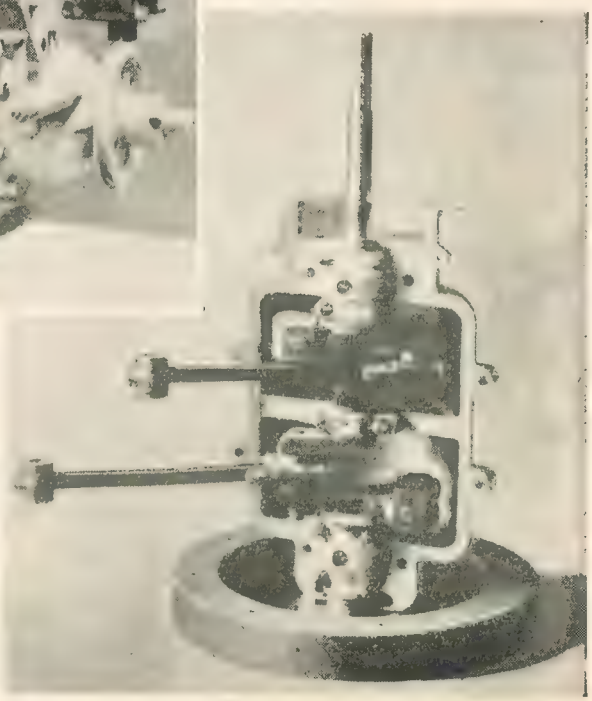
It was one of these three cars which formed the subject of a photograph in a recent television programme "Snapshots," and it is recorded that the Army fully expected C. S. Rolls to go down to Brighton on the day prior to certain manoeuvres, during which he was to drive the Duke of Connaught. Rolls, however, had supreme confidence in the little Royce, and rose early, arriving at Brighton in ample time for breakfast and the appointed meeting. Reliability was not an outstanding feature of contemporary motor-cars, and this journey and the faultless running of the car throughout the manoeuvres, created a tremendous impression on the Army Staff.

A few details of this historic first car may be of interest. The bore was 95 mm. and the stroke 127 mm. The 2-throw, 3-bearing crankshaft was made from a nickel-steel forging, and had bolted-on balance weights to improve its dynamic balance. It had overhead inlet and side exhaust valves, an arrangement to which the latest Rolls-Royce and Bentley cars conform. The crankcase castings, of aluminium, and the cylinder block casting, of iron, were produced in Royce Ltd.'s own foundry.

The "carburator" (spelling as in the first issued catalogue of Rolls-Royce cars) was of Royce's design, with an expanding valve to give flexibility. A butterfly throttle was fitted, and controlled by a hand-set governor or pedal. The ignition system embodied high and low tension commutators and a trembler coil. The standard of these Royce-built components was very high (in direct contrast to contemporary standards) and contributed in no small measure to the efficiency and reliability of the engine. The first engine (completed towards the end of 1903) was bench tested and developed by coupling it to a Royce dynamo, when its power output could easily be measured, and its efficiency assessed in terms of electrical energy. A typical test schedule entry would read: "2 galls petrol—30 amps, 120 volts for 4 hours at a cost of 2s. 2d. per gall = 1s. 7d. per kilowatt hour." The weight of the chassis was 10¾ cwt. and the production 10 h.p. 2-cyl. with tonneau body (rear entrance) sold for £395 complete, in 1904.

This painstaking development, and the adaptation of available units and equipment has reached its logical conclusion in the intensive research and development-rig testing which now enables the company to design, develop and produce engines which, throughout the world, are upholding those traditions embodied in that first 10 h.p. experimental car which emerged from the Manchester works 50 years ago.





Engine of first prototype car. Note the push-rod operated inlet-valve gear, position of sparking plug and modern carburettor

Right: Lower half of engine held the "mains" and counter-balanced crankshaft

BRITISH CRAMPTON LOCOMOTIVES

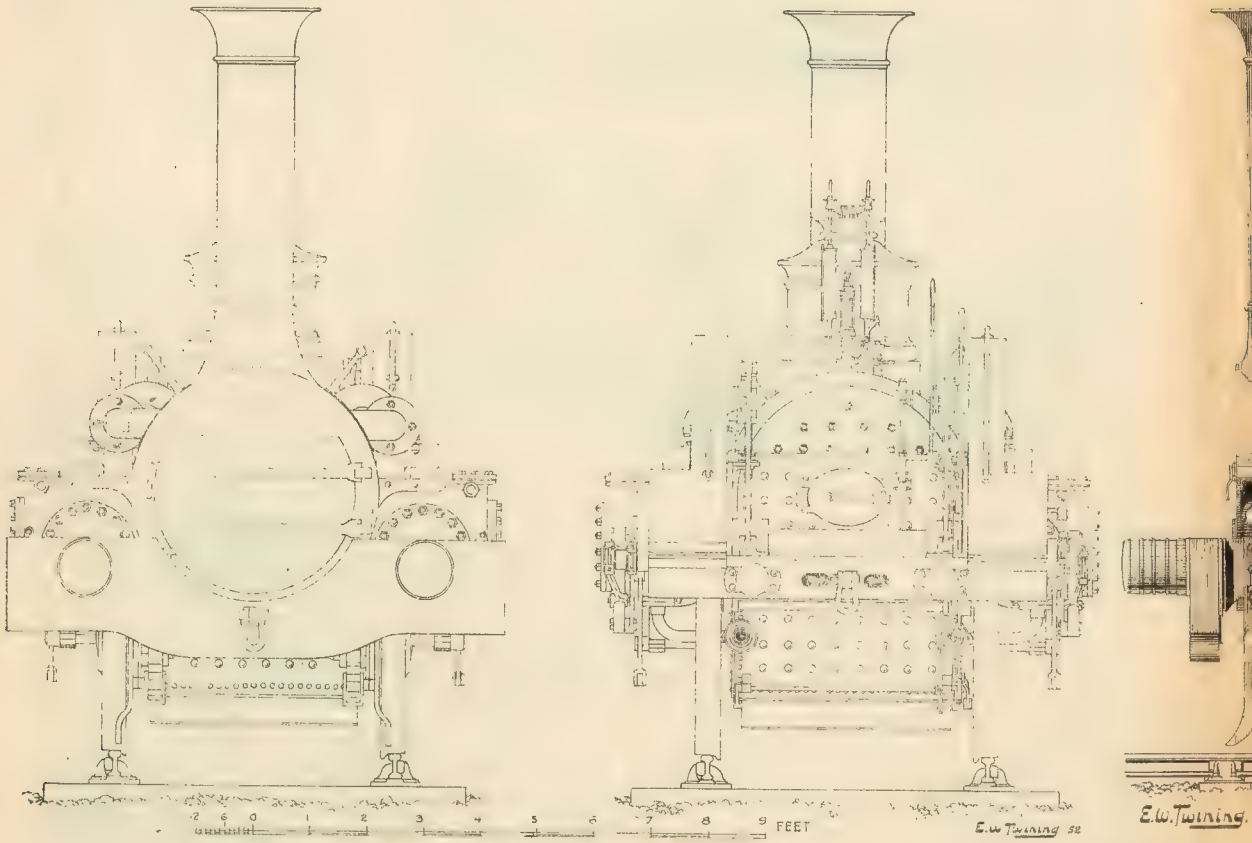
By E. W. TWINING

PART 11

THE last, the very last of Crampton's outside-cylinder stern-wheel engines to be put into service in this country, was one purchased by the Maryport and Carlisle Railway in the year 1854 and bore the number "12" in the company's books. Beyond the fact that, like the first six engines of the type, it was built by Tulk and Ley, of Lowka Works, Whitehaven, the date of delivery and the works number, which was 17, very little was, until quite recently, known about the design and appearance of this engine; indeed there are still one or two facts regarding its history which are somewhat mysterious. Why, for instance, if the engine was not sold until 1854, was the works number next in numerical succession after No. 16, the last of the original six, which went in 1847 to the South Eastern Railway (No. 85) ?

It has been believed, and until now with justification, that the actual date of construction was 1847 or 48, that Tulk and Ley built an exactly similar machine to the others from parts left on hand from the large contract and then kept it in stock for about six years until the Maryport Railway were "bargain hunting."

But this assumption is now negatived by an old blueprint which has recently come to light; which print was made from a still older, and obviously original, contem-



Figs. 27 and 28. Front, back, and side elevations of th

porary tracing. This tracing bears evidence of being on thin paper and was somewhat torn and dilapidated when printed from.

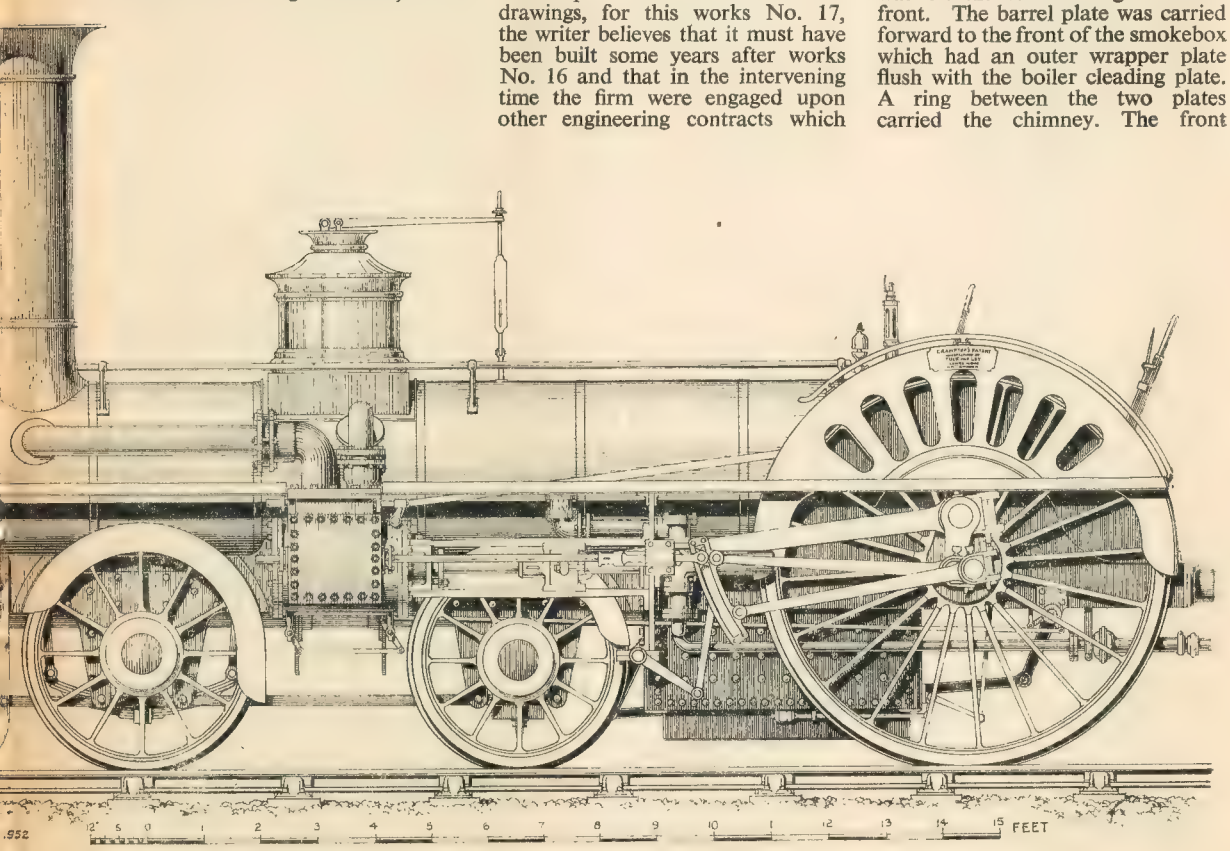
It should be mentioned that the drawing bears proof of its age in the style of written dimensional numerals; but it bears neither title, name of builders, signature nor date. It is unquestionably a Tulk and Ley drawing and, although the engine shown is single-framed, like its forerunners, and not of the double framed type which Crampton adopted in 1848, there are many marked improvements upon the first six; in fact, in detail and in many other respects, this Maryport engine was quite different from the others and could not have been built from spare parts. The boiler was more modern, notably in the design and construction of the firebox and the barrel was circular instead of being of ovoid section.

For the cylinders, the same foundry patterns were probably used but these, with their coreboxes, were extensively altered. The driving horns instead of being inverted, were turned down in the normal way and separate springs were provided for each driving axlebox. The reversing gear was much improved for the doubly cranked arm from the shaft now gave place to a straight arm. There were no eccentric sheaves with straps; instead, the same arrangement was adopted as was used in the L. & N.W.Rly., Crewe-built *Courier* and the return crank, with its two eccentric-pins, the two rods and the expansion link are all shown in the accompanying drawing (Fig. 29) which has, in part been traced from the old blueprint referred to. The cross-section through the cylinder was not shown in the original and this item in Fig. 29 is a reconstruction by the writer. The blueprint is now in the possession of Mr. W. McGowan Gradon of Altrincham, Cheshire—to whom the writer was introduced by Mr. C. Hamilton Ellis—and Mr. McGowan Gradon has very kindly loaned it for the purpose of preparing this article.

In view of the great differences and improvements shown in the drawings, for this works No. 17, the writer believes that it must have been built some years after works No. 16 and that in the intervening time the firm were engaged upon other engineering contracts which bore different works numbers; for Tulk and Ley were not locomotive builders only. From the point of view of locomotive history it was a most calamitous happening that the old Lowka Works were, in comparatively recent times, entirely destroyed by fire, together with a great mass of Tulk and Ley drawings and records, so that we are never likely to gain any further knowledge concerning the locomotives built by the firm; fortunate it is that certain few drawings have survived which must have been in existence outside of the works.

The Maryport and Carlisle engine, No. 12 is shown in side elevation in Fig. 28 and in front and back elevation in Fig. 27.

The principal particulars and dimensions of the engine were as follows: The circular boiler barrel had an outside diameter of 4 ft. 1 in.; it was built in four rings and all joints, both longitudinal and circumferential, were butted and covered by straps, single riveted through each strap and plate. The dome was on the second ring from the front. The barrel plate was carried forward to the front of the smokebox which had an outer wrapper plate flush with the boiler cleading plate. A ring between the two plates carried the chimney. The front



e Maryport and Carlisle Railway engine No. 12.

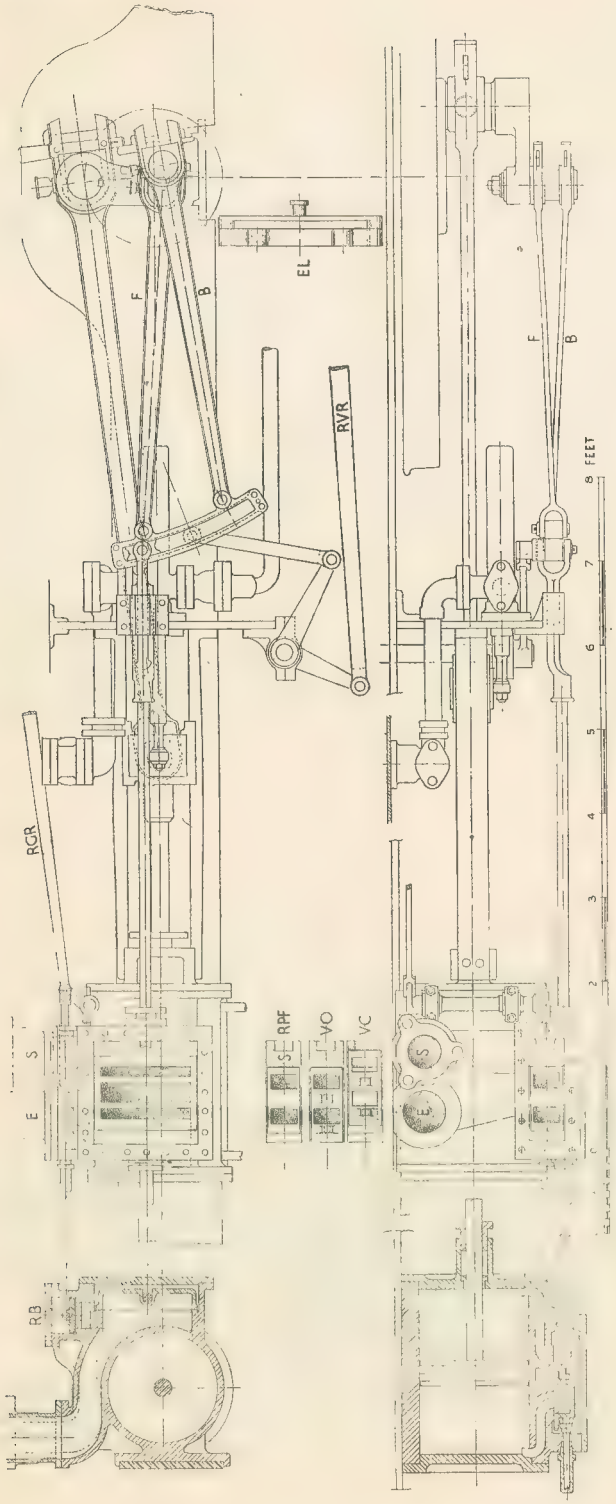


Fig. 29. M. and C. Rly. engine No. 12; details of cylinders, motion, valve-gear, etc.

tube plate was of the flanged drumhead type, the flange turned forward. The firebox of modern rectangular form was 4 ft. 10 in. long with a width of 4 ft. 0⅜ in. at the front tapered to 4 ft. 0 in. at the back; depth from the crown to the foundation ring 4 ft. 4 in. The crown was supported by eight girders and these by ten sling stays. There were 184 flue tubes 9 ft. 10 in. long, each of 1¾ in. diameter, giving a heating surface of 829.25 sq. ft., which, added to 76.75 sq. ft. in the firebox made a total of 906 sq. ft. The grate area was 14 sq. ft. The working pressure is unknown but was probably 90 to 100 lb. per sq. in.

The regulator was in duplicate, a separate one being provided for each cylinder; each regulator valve in a box cast integral with the cylinder and steamchest. These boxes and valves, with their ports, are shown in detail in Fig. 29. In this drawing the reference letters are *S*, steam entry; *E*, exhaust; *RB*, regulator box; *RPF*, regulator port face; *VO*, regulator valve open; *VC*, valve closed; *RGR*, one regulator rod. There was a separate rod for each valve and these were led back to a cross-shaft on the firebox immediately over the firehole door; on the shaft was the driver's regulator handle, all as shown in the back elevation (Fig. 27).

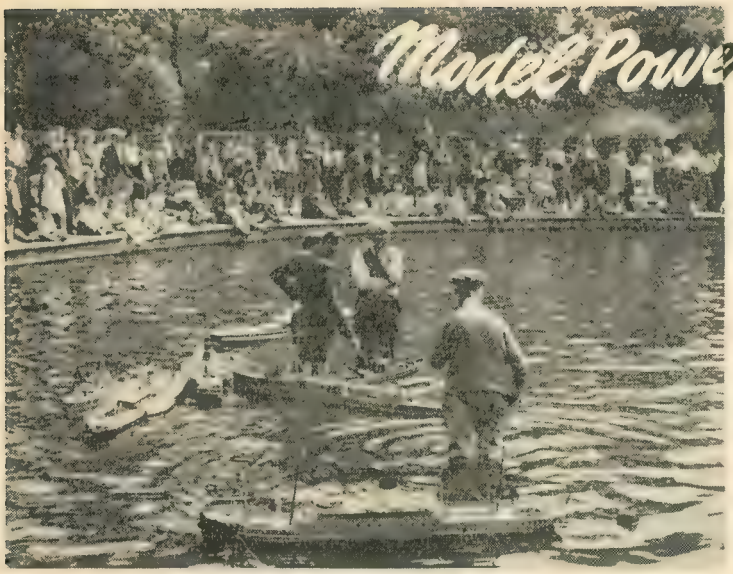
The remaining letters in Fig. 29 are: *RVR*, reversing rod, which was on the right-hand side of the engine; *F*, the forward eccentric rod; *B*, the backward rod, and *EL*, a back elevation of the expansion link.

The cylinders were 16 in. diameter by 20 in. stroke. Driving wheels 7 ft. diameter. Leading wheels 4 ft. 0 in. Intermediate wheels, 3 ft. 9 in. diameter. The wheelbase was: leading to intermediate, 6 ft. 8 in.; intermediate to driving, 7 ft. 10 in. Total, 14 ft. 6 in.

The frames were of plates 1⅛ in. thick with a depth, between the front of the cylinders and forward of the driving axle, of 1 ft. 3 in. From the cylinders to the front buffer beam the depth was 12 in. The leading overhang was 3 ft. 0 in., and overhang at the rear 3 ft. 10 in.; the total length of frames was, therefore, 21 ft. 4 in.

The painting of this Maryport and Carlisle engine No. 12, was dark green and was probably picked out in what became the company's standard style, namely: black with fine vermilion lines. The chimney was all black and the highly ornamental dome wholly of polished brass. Other bright work was: the

(*Continued on page* 327)



Model Power Boat News

BY MERIDIAN

• A REVIEW OF FACILITIES

A typical scene at Victoria Park, London

A FEW months ago I made some comments on the facilities available for the running of model power boats, and at the same time asked for information concerning waters, especially those which might not be well known.

I am afraid that the response to this appeal was not very good, but I feel that this is largely because local clubs are apt to think that the existence of their particular lake is well known. However, if it has never had any particular publicity, through being mentioned in THE MODEL ENGINEER or other Journals in connection with regattas, the chances are that it is not known outside its immediately locality.

In order that the position can be clarified, I have compiled a list of ponds and lakes that can be used for running model power boats, or have been used in the past.

This list has been compiled partly from the current M.P.B.A. list of affiliated clubs, and partly by reference to back numbers of THE MODEL ENGINEER. In many cases there are blanks that need filling in, for example: Barrow-in-Furness, where the actual sailing water is not known, but the existence of a strong model power boat club indicates the presence of a suitable lake. In other cases, waters are known which at the moment do not appear to be used by any organised group, although it is known that regattas have been held there in pre-war days.

Some of those that are listed may be no longer in existence, or perhaps permission is withheld from using them for power-driven craft.

Cove Reservoir, Farnborough, is one of the waters which I believe is now non-existent, due to war-time activities, and the ponds on Wimbledon Common are an example of official bans. There are three that have been used, but at the moment it is not permitted to run power craft on any of them. Several well-known clubs are absent from the list in the last column. These absentees are clubs such as Kingsmere, Orpington and Swindon, who are without a home water.

The list, as shown, must be regarded as only a provisional one, open to amendment and alteration. Apologies are herewith tendered in advance for errors and omissions, but I would appeal to readers to help the cause, by sending the information which would correct and amplify the list and bring it up-to-date. A postcard with the location, name or situation of lake, and facilities is all that is necessary—the editor will pass on all replies. The list shows the lakes that are *known*, so if your model power boat water is not shown, let us know !

Model Power Boats Abroad

The popularity of model power

The Poole model boating lake

MODEL POWER BOAT PONDS IN GREAT BRITAIN

Town	Name and/or Location of Water	Facilities SR—Straight Running CC—Circular Course	Club (if any)
Ayr		SR—CC	Ayr S.M.E.
Barrow-in-Furness ...		SR	Barrow M.P.B.C.
Barry (Glam) ...	Coldnap Lake, Barry	SR—CC	Barry M.P.B.C.
Bedford	Longholme Lake	SR—CC	Bedford M.E.S.
Birkenhead	Gaultby Road	SR	
Blackburn		SR—CC	
Bolton		SR	Bolton S.M.E.
Bournemouth ...		SR—CC	Bournemouth M.P.B.C.
Bournville	Valley Parkway, B'ville	SR—CC	Bournville M.Y. & P.B.C.
Bristol		SR—CC	Bristol M.P.B.C.
Bromley (Kent) ...	Whitehall Rec. Ground	SR	Bromley M.P.B.C.
Cardiff	Roath Park Lake	SR—CC	
Cheltenham ...		SR	Cheltenham S.M.E.
Coventry	Nauls Mill Park	SR—CC	Coventry M.E.C.
Crosby		SR—CC	Crosby M.C.
Derby	Allestree Park, Derby	SR—CC	Derby M.C. & P.B.C.
Eastbourne	Gilbert Park	SR	
Enfield (Middx) ...	Albany Park	SR—CC	Enfield M.E.S.
Falmouth	Swanpool Lake	SR—CC	Falmouth M.C.
Farnborough (Hants)	Fleet Pond (special permission necessary)	SR—CC	Aldershot S.M.E. Farnborough S.M.E.
Fleetwood	Marine Lake	SR	
Glasgow	Maxwell Park	SR—CC	Glasgow S.M.E.
Guildford	Stoke Park	SR—CC	Guildford S.M.E.
Hartlepools	Ward Jackson Park	SR	Hartlepools M.Y. & P.B.C.
Hastings		SR—CC	Hastings M.E.S.
Heaton	Paddy Freemans, Jesmond Dene	SR	Heaton M.P.B.C.
Kettering	Wicksteed Park	SR—CC	Wicksteed M.P. & P.B.C.
Kings Lynn		SR—CC	Kings Lynn M.C.
Liverpool	Newsham Park	SR	
London:			
Barking E. ...	Barking Park	SR	Barking M.E.S.
Blackheath S.E. ...	Princess of Wales Pond	SR—CC	Blackheath M.P.B.C.
Clapham S.W. ...	Long Pond, Clapham Common	SR	Fulham & Dis. M.P.B.C.
Forest Gate E. ...	Yacht Pond, Dames Rd.	SR	F. Gate M.P.B.C.
Hackney E. ...	Victoria Park	SR—CC	Victoria M.S.C.
Hendon N. ...	Welsh Harp	SR	Elettra M.P.B.C.
Herne Hill S.E. ...	Brockwell Park	SR—CC	S. London M.E.S.
Highgate N. ...	Highgate Ponds, Parliament Hill Fields	SR	N. London P.C.C.
Kensington W. ...	Round Pond	SR	W. London M.P.B.C.
Wood Green N.	White Hart Pond	SR	Wood Green M.P.B.C.
Manchester ...	Heaton Park	SR—CC	Altrincham M.P.B.C.
Manchester, Wilmslow	Lindlow Common	SR—CC	Altrincham M.P.B.C.
Maghull		SR—CC	Maghull M.E. & E.S.
Morecambe ...		SR	Morecambe M.Y. & P.B.C.
Poole	Poole Harbour M.Y. Pond	SR	Poole M.Y. & P.B.C.
Portsmouth	Canoe Lake, Southsea	SR	Portsmouth & Dis. M.P.B.C.
Reading	Christchurch Meadows	SR	
Rochdale		SR	Rochdale S.M.E.
Runcorn		SR—CC	Runcorn M.P.B.C.
St. Albans	Verulamium	SR—CC	St. Albans M.E.S.
St. Helens	Leg of Mutton Dam	SR	
Southampton ...	Ornamental Lake, Southampton Common	SR—CC	Southampton S.M.E.
Southend	Southchurch Park	SR—CC	Southend M.P.B.C.
South Shields ...		SR	
Stourbridge ...		SR	Stourbridge M.C.
Sunderland	Roker Park	SR	Sunderland M.B. & E.C.
Tynemouth ...	Tynemouth Park	SR	Tynemouth M.Y.C.
Wallasey	Central Park	SR—CC	Wallasey M.P.B. & Y.C.
York		SR	York & Dis. S.M.E.

The far side of the lake at Poole

The lake at Southchurch Park, Southend-on-Sea

boats in any particular country must surely bear some relationship to the number of waters available, and it must be admitted that in this country we are not too badly off. Many of our model boating lakes were originally constructed more than 40 years ago, and some of our clubs date back to the early nineteen-hundreds.

It may be reasonably claimed that Britain is the home of this hobby, but it is a great pity that it is not more popular in other European countries.

As regards France, M. Suzor has pointed out that the power boat enthusiasts of the M.Y. Club de Paris have never had the use of a pond reserved exclusively for model boats. Recent international events have been held at Le Visenet, which is situated some distance outside Paris—a good water, but rather inconvenient for practise purposes, due to the fact that transport is necessary for the circular-course equipment.

Model boating lakes would appear to be scarce on the Continent and this probably explains—at least partially—the fact that there are not so many power boat clubs as in the British Isles. Such information that is available indicates that at present there is little power boating activity outside of France and Switzerland. The M.Y. Club de Paris is the premier club of France, and in addition to the numerous racing enthusiasts, has about sixty members who run prototype or other free-running boats. Power boats in Switzerland are upheld by the Model Racer Club of Geneva, and the Chevrot brothers are well known to us by their visit to this country in 1950.

In the U.S.A., power boats seem to be very popular, and in the racing class, records have been set up that will take some beating. An interesting point is that America is the only other country to have a national organisation comparable with our own M.P.B.A. The main centres of activity appear to be at or near large cities like New York, Chicago, Detroit, etc., but there is much interest in many other places. There is a very strong club in Toronto, Canada, and international events often take place.

I am pleased to say that Bob Graham, a well-known American enthusiast, has sent us a lot of information about power boating over there, and it is hoped to publish some of this in future editions of "Model Power Boat News."

BRITISH CRAMPTON LOCOMOTIVES

(*Continued from page* 324)

copper pipes, the brass of the feed pumps, the whistle, safety-valve columns and other fittings. The splashers were probably all painted green though the leading pair may have been of brass.

It would be of interest to model makers to note that the arrangement of the main cranks was for the left-hand crank to lead.

In conclusion, the writer would add that, although only 25 engines of this type were ever built in this country, on the Continent the Crampton was very well liked and extremely popular, particularly in France and Germany, where upwards of three hundred of them were built and continued on all the high-speed express trains, some of them well into the 20th century.

During the course of preparation of drawings for and the drafting of these articles the writer was asked why he does not deal with Crampton's two other types of patented engines, both with inside cylinders driving wheel-less crank-shafts : one, the 4-0-2-0 type and the other the 2-0-2. The answer was that he is not interested in either of them, because, the first might equally well have been of the 2-4-0 or the 4-4-0 type, which latter they were shortly altered into, and the other, the 2-0-2, was converted to 0-6-0 or ordinary six-coupled goods. In both cases the converion simply involved adding wheels to the dummy crankshafts.

Why Crampton ever conceived the idea of putting in a cranked axle with no wheels upon it the writer cannot understand, because a shaft crossing underneath the boiler, with cranks and connecting-rod big-ends, puts the height of the boiler centre-line up to where it would be in any normal engine, and, therefore, defeats the very purpose which Crampton set out to achieve, and did achieve, with his outside cylinder, rear drive type. Furthermore, the two freak types mentioned are scarcely likely to interest model makers, any more than they did French and German railway engineers. On the other hand, the stern wheelers, with their outside gear, definitely are interesting and would make, most of them, very beautiful models.

Musical Mechanism

THE RECONSTRUCTION OF AN OLD POLYPHON

By "Aeolus"

FEELING convinced that repairs to large, high-class music boxes are within the scope of a model engineer, and knowing that there are hundreds of these fine mechanisms lying derelict in various parts of the country, I resolved to try my hand at salving one or two. With more ambition than due regard to the time involved in such repairs, instead of one or two, four "dud" boxes were acquired. One, the subject of this article, is a disc playing instrument, while the others play by means of pins protruding from brass cylinders or drums, 2 in. to 4 in. in diameter, and 12 in. to 14 in. long.

As it is the largest and my workshop is small, the disc machine was tackled first. Music boxes of this type have a volume (but not the tone) of a small upright piano. Their music is superb and extremely charming. The range of tunes played is only limited by the number of discs available.

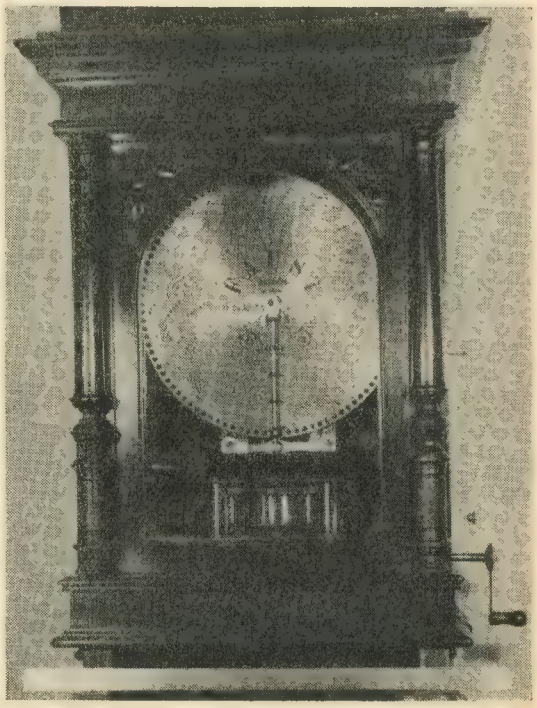
Before detailing a few renovations, for readers unfamiliar with this particular kind of musical mechanism, it will be necessary to say something about the playing part of the instrument. The clockwork movement is very powerful, but, being fairly simple, it needs no description beyond a mention that it is controlled by a penny-in-the-slot mechanism, and it operates for about three minutes when a coin is inserted; it stops automatically at the end of the tune. In passing, it may be said that the whole music box had been very badly treated before it came into my hands—in fact, it was little more than scrap and beyond *economic* repair. I found the redemption of so delapidated a musical relic of the past, (it was manufactured about the turn of the century) particularly gratifying.

An idea of the size of the machine will be gathered from the two-foot rule, discernible under the cabinet in Photographs Nos. 1 and 2.

This "Polyphon," for that is the name of the make of this music box, plays a 15½ in. disc, with a $\frac{5}{16}$ in. hole in its centre. The disc is made from 38 S.W.G. sheet steel, has the name of its tune printed on one side of it, and a large number of lugs, integral with the disc, and corresponding to the notes to be played, are pressed up and formed at varying radii on the other side. These lugs are about 3/64 in. wide and stand out from the surface about $\frac{1}{16}$ in. They are doubled back on to the disc itself, in the form of a staple-shaped loop. This gives strength and rigidity, see Fig. 1A. Discs were lacquered to prevent rust (be it said, without complete success), and are rotated and driven by a "gear" wheel, fitted with 16 hemispherical or dome-headed screws instead of normal teeth. These engage in the round perforations seen near the edge of the disc in Photograph No. 1.

Two cast-steel playing combs, with teeth facing each other, are mounted on a heavy c.i. baseplate, which, in turn, is attached to the back of the wooden casing (forming a sounding board) by means of four large wood screws. (See Photograph No. 3). The individual teeth of these combs are tuned after the manner of tuning forks. Each gives its distinctive musical note when struck or plucked and forms one note in a scale. Some of them, the larger ones, with deep notes, have various-sized resonators attached to their backs by solder. These do not show in the photographs, as they are behind the teeth, but Fig. 1B is a diagrammatic sketch of one of the largest. The resonators are rectangular lead weights, and are specially mentioned because they are often damaged or missing in ill-used machines. In this instance, a few were detached, but fortunately were found lodged behind the bedplate. Resonators were used by the makers as one means of tuning the teeth. The heavier they are, the deeper the note produced; they are difficult to replace, if lost. It is essential that they be firmly fixed and correct as to weight, size and position—or the teeth will be out of tune. When new ones have to be fitted, the teeth affected must be retuned by adding to or reducing the weight.

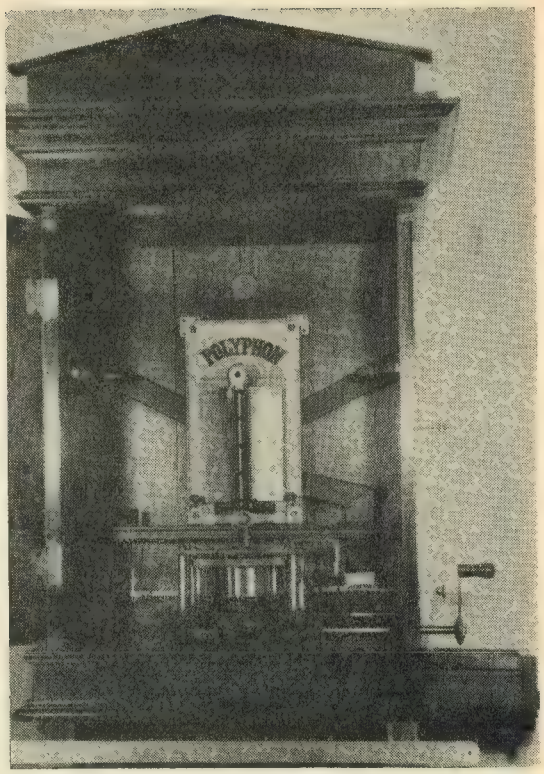
The combs each have 38 playing teeth (in case anyone counts those in the photographs, there are some that do not play !) and both look much alike but are different musically; their physical differences can be detected by close examination.



Photograph No. 1. *View of music box, with door closed*

As the disc revolves, the projecting lugs are arranged to pluck, at varying intervals, one or more of the 76 tuned teeth. Obviously, this number gives the machine a good musical range, although there are music boxes with up to 200 teeth, and a few with more. The contact between the lugs on the disc and the teeth is indirect, and takes place through the media of small ratchet-like star wheels (see Fig. 1c), about $\frac{3}{4}$ in. in diameter, and 0.033 in. thick; each has 9 teeth and is made of steel. They are mounted and evenly spaced on a vertical shaft of about $\frac{3}{16}$ in. diameter, situated midway between the two opposed combs. The star wheels are actuated by the lugs on the revolving disc, which, on contacting a star wheel tooth, moves it one station forward. Each movement of a star wheel causes one of its teeth (i.e. not the one contacted by the lug), as it travels from one station to the next, to pluck the tip of the tuned tooth corresponding to it, thus a musical note is produced. The shaft carrying the star wheels runs from top to bottom of the combs and there is one star wheel for each tuned tooth. This shaft also carries two rotatable steel washer-like members, about 49/64 in. in diameter and 0.033 in. thick, which act as jockey pulleys by resting against the inner surface of the disc as it revolves, thus preventing the lugs from meshing too deeply with the star wheels. The disc lugs are so arranged that none is in the track of the jockeys.

The disc is held in playing position by a light steel bar (later called a clamp arm), the lower end of which is hinged and it swings outwards from a slotted yoke forming part of a cast-brass bracket screwed to the baseplate; it may be observed in the photographs. At its upper extremity, viewed when closed, there is a small banjo, in which is housed a lever-operated spring catch, serving to clip it to a slot in the central spigot, which, in turn, supports the weight of the disc by passing through its central hole. The clamp arm carries six narrow rollers, made of ebonite or similar material, suitably held apart by tubular spacers. These rollers hold the disc up to its work by gently pressing on its outer, or smooth surface, Photograph No. 1. Two pear-shaped wooden rollers at the bottom of the baseplate (see Photograph No. 3, at bottom corners of the combs) are mounted on short pillars. Two more, much larger pear-shaped rollers (also of wood) are attached, by means of ornamental cast-brass brackets, to each side of the wooden cabinet, in a horizontal line with the central spigot—see Photograph No. 3. The object of these four rollers, each of which is so situated as to run against the inner side of the outer edge of the disc, is to spring it into a slight curve; this they do by reason of the fact that all of them are on a level a little nearer to the front of the cabinet than the inner faces of the six rollers on the clamp arm. This is very important, and is remarked on because some of these parts were missing, and some wrongly assembled, when the machine came into my hands. It might therefore, have been rather



Photograph No. 2. View of music box with door open, showing triangular pediment and cash drawer

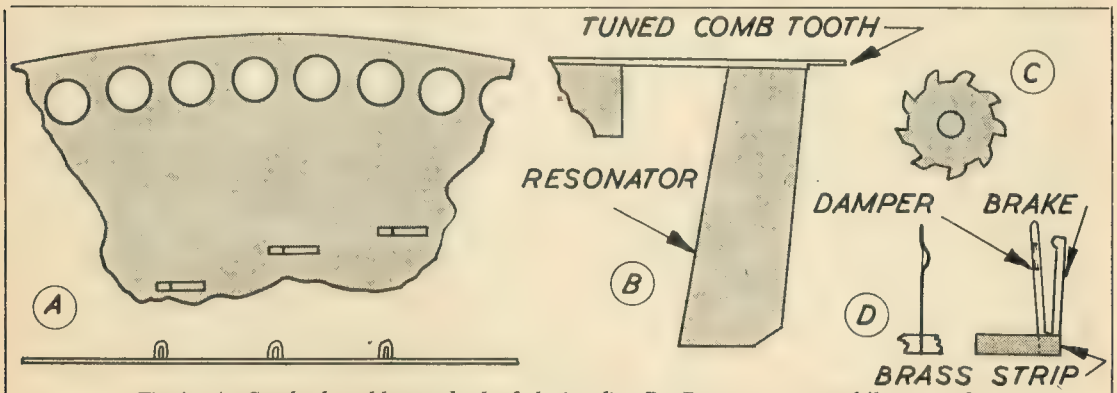
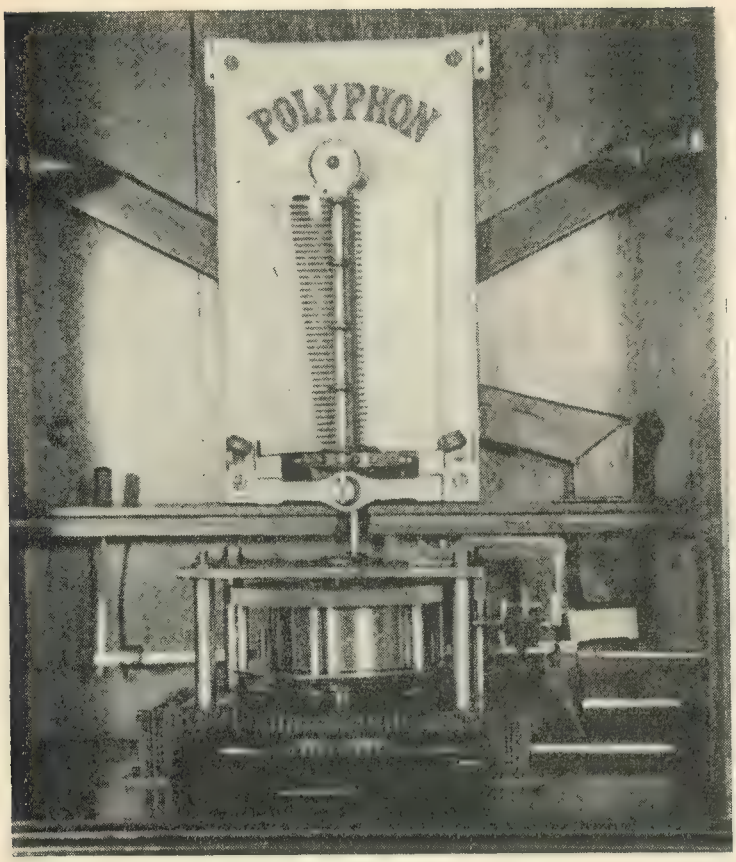


Fig. 1. A—Staple-shaped lugs on back of playing disc. B—Resonator on tuned (bass) tooth. C—Star wheel. D—Damper and brake



Photograph No. 3. Close-up, showing arrangement of works. The mainspring of these clockwork movements is tremendously powerful, and can cause serious injury if released suddenly

difficult to envisage their positions and exact function without previously having seen a similar machine in action. This springing of the disc is an ingenious method of temporarily stiffening and guiding an otherwise flexible, not to say "floppy" and difficult component to handle mechanically.

There is another series of essential mechanisms, one item of which is mounted between each of the star wheels and its related tuned tooth. These are the dampers. Properly adjusted dampers are absolutely necessary, because, if a tooth of a star wheel contacts a comb tooth while the latter is in vibration after being plucked, a jarring, buzzing noise is made, completely spoiling the harmony. This unpleasant sound is caused by the tuned tooth vibrating against the tip of the star wheel tooth as they approach close to each other, and touch.

The two combs are set at different angles and levels, that on the right being higher in relation to the centre of the star wheel shaft than the other. The star wheels pluck the teeth of the right hand comb "upwards" and those of the left, "downwards" when looking at these parts mounted on the music playing sub-assembly lying in a horizontal position on the work bench. For this reason, the dampers differ slightly as between the two combs, but as their action is practically the same in both cases, it will only be necessary to describe those on the right hand side.

The dampers (with one set of which are combined "brakes" for the star wheels—all these are on the right hand side) on this particular machine work on the following system, but it should be noted that although dampers on cylinder type machines serve exactly the same purpose, they are quite different in form.

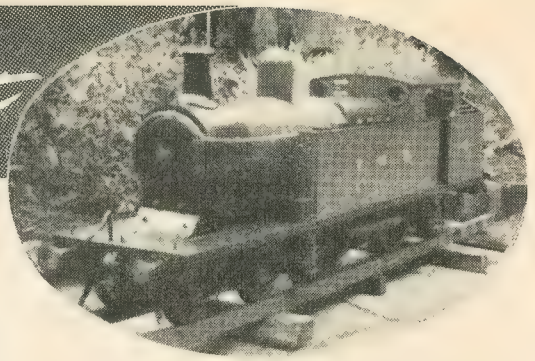
Fig. 1D is a sketch of a damper of the kind used on the right hand comb. The dampers are made of spring steel and brass plated, but in some machines of this make they are of spring brass, or, it is believed, of German silver. Each damper has a curve formed in it which, normally, is sprung against the side of one tooth of its related star wheel when the latter is in its rest position, and is thus kept out of contact with the tuned tooth. As the star wheel is moved round towards its next station by the disc lug, the curve of the damper springs over, out of its vertical position, into the space between the tooth which has just left it and the next one coming up. In this intermediate or mid-position, its tip is sprung over hard against the side of the tip of the tuned tooth, thereby stopping it from vibrating, or, in other words, damping it. The movement towards and on to the tuned tooth is due entirely to natural and inherent springiness. The next oncoming star wheel tooth, in its turn, then moves the damper by coming in contact with the curve, thus pressing the damper arm away from the tuned tooth, which is immediately freed from damping effect. At this stage, the tuned tooth is plucked by the same oncoming star wheel tooth and emits its note. The lug then loses contact with the star wheel tooth, and the star wheel comes to rest.

So far, the damper arm has been dealt with; the other arm, with no curve in it, is termed a brake in Fig. 1D. This tongue of metal is sprung against the side of the star wheel (sufficiently near to its centre as to be clear of its teeth) and serves to prevent the star from over-running or getting away from its normal rest position without the aid of the disc lug.

The sheet metal channels down which the pennies run can be seen passing behind the music playing mechanism (coins may be inserted at either side of the machine) and the rectangular "cup" into which the money falls is at the end of the lower channel on the right of Photograph No. 3. The weight of the coin depresses the "cup," which is balanced on a weighted arm, and thus starts the movement by releasing a wire "arm" attached to the "fly." As movement continues, the "cup" is further depressed and also tilted by a cam until it ejects its contents into a drawer below. The "cup" then comes slowly back, nearly to its first position. The cycle is ended when a pin on the balanced arm drops into a hole in a revolving plate, and so stops the clockwork by making contact with the "arm" on the "fly." This "arm" is merely an extension of the end of a coiled spring wrapped round the spindle of the "fly."

(To be continued)

L.B.S.C.'s Lobby Chat



A 5-in. gauge G.C. tank engine built by "Messrs. Taylor & Son" of Leicester

• THE ETERNAL QUESTION

ARISING out of various comments I have made from time to time, on the question of the £ s.d. side of locomotive building, some letters have come to hand, asking if I would offer a little advice to those good folk whose enthusiasm soars high above the modest depth of their pockets. O.K., anything to oblige; so here goes. A typical letter comes from a reader who started taking this journal just before the *Britannia* serial started. Our friend says that he was fired with the ambition to build the engine, and could have done so, by following my instructions, IF he had owned the equipment to which I referred from time to time; but that insignificant little word of two letters, "red-lighted" the whole outlook. He had nothing, and no wherewithal to purchase anything, so he "built" the engine in imagination, carefully reading the instructions, in the hope that some day he would own a workshop, and be able to follow them out, and build the engine in reality. I know exactly what he feels like; I remember, as if it were only yesterday, gazing with longing eyes at a little toy locomotive in a shop window in Queen's Road, Peckham, and wishing that I had the money to buy it. It was only five shillings; I didn't possess five farthings. That was well over sixty years ago. However, there was one thing that the poor poverty-stricken kid was rich in, and that was enterprise. If I couldn't *buy* the engine, I'd *make* one ; how that was to be done, was a moot point at the time, but the determination was there. As it happened, I was later able to buy one, by aid of a fond granny, and regular followers of these notes will probably be able to recall the story recorded in my childhood reminiscences; but that didn't in any way upset my resolve to build working steam locomotives myself. The few good folk who have seen my present workshop, railway, and fleet of locomotives, won't need telling that the "dream came true"; but the start, and the going, were hard for many years.

Where There's a Will, There's a Way

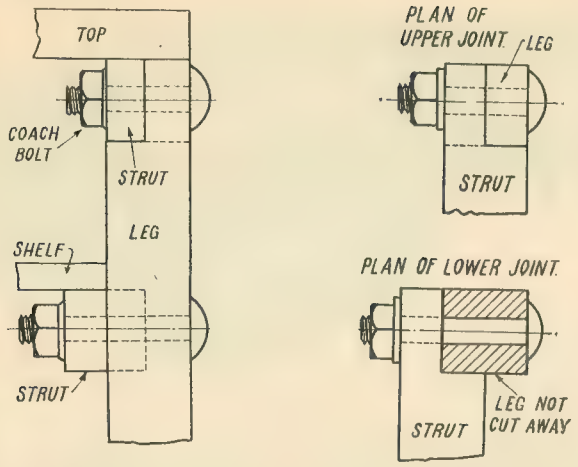
Let's take a hypothetical case, and imagine that somebody wants to build a locomotive, but has no knowledge of the whys and wherefores, little or no skill in using tools, and no equipment. The engine cannot be brought into being, by waving a stick and saying: "Eyntimmin-ongye-iron" (some folk reckon that I do it that way !), and a few tools are necessary to make a start. Some material will also be needed. There is an old saying, that you should cut your coat according to your cloth; and this applies in the present instance. Presumably, the budding locomotive builder is in regular employment, earning wages or salary, so the first thing to do, is to settle the amount of cash which will be available. Now a word to the wise. Whilst a lathe is an essential, *it isn't the first thing that should be bought.* This is a common error; our unfortunate friend to whom I referred in the last issue of 1953, made it. Most lathes can be purchased by instalments—I bought my first Drummond on the "never-never"—and it is certainly a great temptation, if you find that your "allocation" (I *hate* that word !) just covers it, to forward the down payment and have the machine in your possession. But if you just have the machine, with not even a few turning-tools or drills, and the instalments swallow up all the spare cash that you can afford, what's going to happen to your locomotive building ?

The correct way is to settle on the type of engine that you wish to build. Raw recruits should choose the easiest and simplest job that is available, not only because it *is* easy and simple, but because it will also be the *cheapest*; and that is a factor, when funds are low. The first job always described in my notes, is to cut out the frames. Right; spend your first available cash on the frame steel, and the tools needed to cut them out. Get a bench vice for holding the metal, a hammer, centre-punch, scriber, hacksaw, drill-brace, drills, and files. A kitchen table with a stout top will serve very well as a bench, but if the usual "houshold handyman's" tools are available, such as a carpenters' brace and bits, wood saw, screwdriver and chisel, a stout bench could easily be knocked up by anybody with average gumption. A handy size for the job, would be about 5 ft. long and 2 ft. wide, with legs 4 in. square, and the top board which has to withstand "bashing," about 2 in. thick. The joints can be made in two wags of a dog's tail, as shown in the sketch, which will probably give professional carpenters and joiners a fit. I'm no carpenter, and I made the joints in the framework that carries four of my countershafts in that way; they have "stayed put" for twenty years.

If funds will run to it, a steel rule and a pair of dividers can be bought for marking-out; young Curly used a wooden school rule, and a pencil compass that cost a penny. My scriber was one of mother's hat-pins, and a centre-punch was made from the broken end of a pointed steel spindle. A hacksaw for cutting sheet metal should have fine teeth; coarser blades can be bought afterwards. With the above modest equipment for a start, you can go right ahead and cut out your frames. If you can only afford two or three files, get one flat, one half-round, and either a square or triangular, all second-cut. Now you are actually starting to build a locomotive, so should feel "on top of the world."

Making Progress

The next stage will be fitting the hornblocks, and then making the buffer-beams, and erecting the frames. No lathe is needed for these jobs,



Simple, strong joints for bench legs or shafting frames

the equipment already acquired being sufficient; so you don't have to bother about the lathe just yet. Now I don't advocate buying finished parts, for two reasons. First, if you are going to build a locomotive, then BUILD it; there is a vast difference between actually *building* anything, and just assembling it from finished parts. Any intelligent kiddy with a screwdriver and a pair of pliers, could do a whole heap in the assembling business, but precious little in actual making. Secondly, the difference between the cost of raw materials and finished parts, can be put towards buying further equipment. Bear this in mind; money spent on tools and machinery, is not just expenditure, but *investment*. That's a distinction with a difference, too. If, for example, you spend 3s. 6d. on a packet of "fags" the money literally "goes up in smoke," but if you spend it on one of the small tools that we use in locomotive building, it is an investment that will start paying dividends as soon as you start using it, and continue to pay them. If, for some unexpected reason, you find that you will have no further use for it, you can still get some of your money back. A correspondent once told me that every time he bought anything for his workshop, his wife nagged him for "wasting his money." It came to pass that she had a serious illness, necessitating special treatment and a long convalescence, which wiped out all their small savings; but by selling some of the products of his "wasted" money, they pulled through. There was no more talk of workshop equipment being so much money wasted, after that!

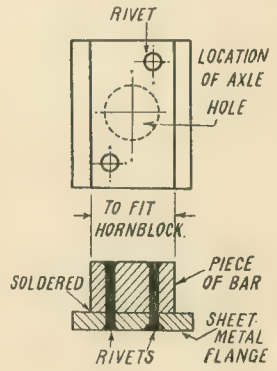
I usually specify angle material for buffer and drag beams, and to mark the ends and frame slots correctly, a small try-square is required. Just a simple cheap one will suffice; in fact, it could be home-made, as anybody who remembers the lessons in elementary geometry, learned in schooldays, should be able to set out a 90 deg. angle on a bit of metal, and cut it out. Young Curly's home-made appliances were a scream, but they served the purpose for which they were intended! The ends of the beams can be finished with hacksaw and file, and the frame slots cut by holding the angle vertically in the vice jaws, with the marked line of the slot, just visible. Start the cut with the hacksaw, and finish with a thin file, which the vice top will guide.

For the still lathe-less builder, the hot-pressed hornblocks are a better "buy" than castings, as they need no machining on the side which bolts to the frames. However, castings can be used, and the bolting side cleaned up with a file. This isn't such a long or difficult job as might appear at first sight. If the casting is held horizontally in the vice, with the bolting side just clear of the jaws, it doesn't need many strokes of a file, to smooth off the roughness, and reduce the outside of the jaws, sufficiently to fit the frame openings. All the rivet-holes will naturally have to be drilled with the hand-brace, but this is merely a matter of patience. Each hornblock is fitted to an opening in the frame, and the holes in the hornblock used as guides for drilling holes in the frame. These are countersunk on the outside, with a larger drill in the hand-brace, and rivets put in, as described in my "serial stories." The two frames can then be put "back-to-back" in the vice, and the hornblock jaws cleaned out with a file, the frames being temporarily riveted together at each end, to keep them in alignment while this is being done.

Taps and Dies

To erect the frames, a little more equipment is needed, viz. screwing tackle. Taps and dies may be purchased singly, and if cash is still scarce, just buy the tap necessary to tap the screwholes in the fixing angles of the buffer-beams, and another one for tapping the hornblock feet, if a different thread is specified. Then, by following the erecting instructions for the particular engine that you are building, you can erect the frames, and your locomotive is beginning to take shape.

If finances will run to it, an assortment of taps and dies can be acquired. I would suggest a set of B.A. taps and dies from 0 to 10, which would cover all the smaller sizes of threads specified in my instructions. Where I specify 5/32 in. × 40, the 3 B.A. could be used, to save expense; and the 2, 1, and 0-B.A. substituted for $\frac{3}{16}$ in., 7/32 in. and $\frac{1}{4}$ in. × 40 respectively. However, if it won't break the bank, it would be advisable to get the 40-pitch tackle as well. If these taps and dies are purchased as opportunity offers, you'll soon find that you are all set for most of the screwing and tapping entailed in the locomotive-building job. If a complete set is bought, die-holder and tap-wrench will be included,

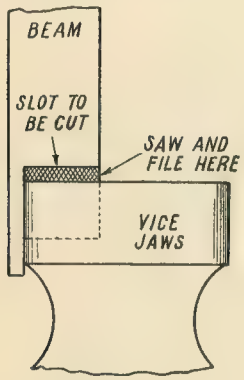


Easy way of making axleboxes without machining

and this will fit the 40-pitch merchants as well.

Now we are getting near the stage when the "King of Tools" will be needed; and here, the observations which I made in the tale of the disabled prospective locomotive-builder, could be studied.

with advantage. Unless some cash has been saved, which would cover the price of a good hefty used machine, the only thing to do, is to get a new one on the—to put it politely—" out of income " system; and readers can rest assured, that those of our advertisers who supply thus, will give them a square deal. So you can choose your machine with every confidence, send your down payment, and while awaiting delivery, in joyful anticipation, get on with one or two other items which can either be made with what you've already acquired, or by additions to them without any great extra expenditure.



How beginners can slot beams by hand

Fabrication

Even when the lathe arrives, you can't use it at once, unless it has a " built-in " drive (motor or treadle) plus tools and accessories. While waiting for these, parts such as the axleboxes could be built up. On some of the 2½-in. gauge engines which I have described, the axleboxes have single flanges, these going between the frames and wheels. It is easy enough to make these, without any milling at all, and the built-up boxes are just as efficient. All you need, is a piece of bronze or hard brass bar, which will fit nicely between the jaws of the hornblocks, and is the same width; also a piece of 16-gauge sheet brass. Saw off from the bar, sufficient lengths for the number of axleboxes required, and leave them full length. Then put each one in the bench vice, and file the ends square, checking with your try-square.

For the flanges, cut out a piece of sheet brass for each box, a little bigger than the size of flange shown on the drawings of the engine that you are building; 16-gauge brass can be cut with a fine-toothed hacksaw, which will leave it flat. Even if you had a large pair of snips, it requires a very strong wrist to cut this thickness, and the metal would tend to curl. Lay the pieces of sheet brass in the shovel used for stoking the kitchen fire, so that they don't touch each other. Set an axlebox on each one, and anoint them with a drop of liquid soldering flux, which can be bought at most ironmongery stores. Hold the shovel over a gas ring, or burner on the domestic stove, until the flux boils away, and then touch each with a strip of plumbers' solder. It only needs a very little, to sweat in between box and flange. Let them cool until the solder sets, then tip off into the sink, and wash under the tap. Put two copper rivets through box and flange; these can be just bits of copper wire. Drill holes through box and flange, at any place which will be clear of the axle hole; slightly countersink on both sides, put the bits of wire through, hammer flush on both sides, and file smooth. The flanges can then be filed to size, and the boxes fitted to the horns, marking each box and the corresponding horn with dots, so that they can be replaced correcly when removed for drilling the axle holes. The above gives an idea of how a raw beginner can start from absolute zero; more later, if all's well.

Trade Topics

The Wolf Cub Fretsaw Attachment

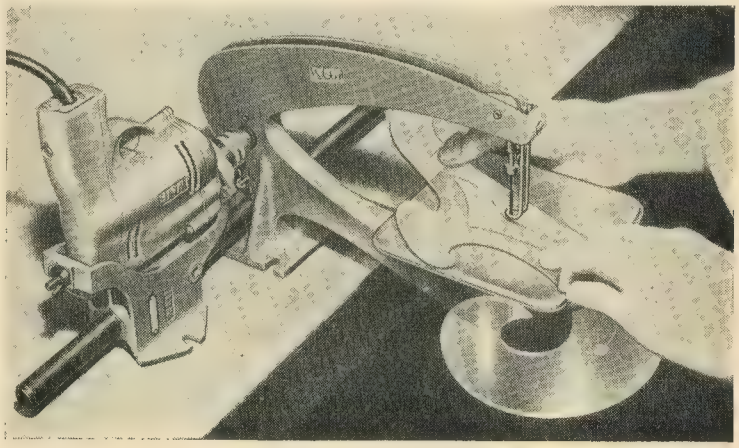
The latest addition to the Wolf Cub range of equipment is an ingenious fretsaw machine which can be driven from the Wolf Cub electric drill, and is capable of cutting wood up to ½ in. thick and non-ferrous metals up to ⅛ in. thick. The drive is applied by means of an arbor which fits the drill chuck, through an eccentric and rocker mechanism which transmits reciprocating motion to the saw blade by means of two flexible nylon belts. Specially designed blades are employed, and blades are easily changed and adjusted to correct tension.

The work table is of pressed steel, 6 in. square, and is equipped with an adjustable guard and workholder which holds the work down while cutting and protects the saw blade. The operating speed is 2,000 strokes per minute, and the throat depth is 8 in., enabling work to be cut to the centre of a 16 in. diameter circle. Twelve blades for wood, plastics, etc., and twelve for non-ferrous metals, are supplied with the set, which sells at a low price, and extends still further the variety of operations which can be carried out with the Wolf Cub drill and its accessories.

All-rubber Electrical Fittings

Messrs. W. W. Haffenden Ltd., Richborough Rubber Works, Sandwich, Kent, have sent us samples of a new range of Duraplug electrical fittings, the special feature of which is that with the exception of the metal conductors, they are made entirely of hard and semi-hard rubber. This not only ensures an extremely high insulation resistance, proof against water and chemical action, but also immunity from mechanical damage.

The new fittings include a 15-amp. three-pin plug of the rectangular pin type, fitted with an infernal fuse, a 5-amp. three-pin plug with the more common round split contact pins, and an all-rubber coupling socket cover for 5-amp. fittings.



READERS' LETTERS

Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

PISTON-VALVES

DEAR SIR,—I was extremely interested in the letter from Mr. Burdett *re* "Piston Valves" because I have experienced the same trouble myself. Many a time I have fitted piston-valves as per our worthy maestro's "words and music" only to find that they blew badly. I put this down to bad workmanship in the reaming operation and hid my head in shame. But I am now wondering whether this is common experience.

Nowadays I always lap my liners and turn the bobbins from oversize stuff to a fit of — 0.0005 in. and get no trouble at all.

Yours faithfully,

Brighton. L. H. B. WOODHEAD.

IGNITION PHENOMENA

DEAR SIR,—I would like to put in a disclaimer to counter the suggestion in Mr. Trott's letter that the theories put forward in my letter of October 22nd were mine. The theories are the result of many years investigation by teams of people, who have specialised in the subject. I advanced them in an attempt to show how established spark theory would apply to the oiling up of plugs.

As I have been prodded into writing once more, I would like to suggest that the possibilities of electrostatic precipitation of oil or fuel droplets on the plug is remote. In order that this may occur the following conditions must obtain:

1. The fuel or oil must have a low electrical resistance, otherwise the droplets will not acquire a charge when formed. This is an experimental fact.

2. The velocity that a droplet can acquire in an electrostatic field is of the order of 3 to 5 feet per sec.

In the light of the second requirement let us assume we have a charged droplet in the span between the electrode and the plug body, and this span is $\frac{1}{16}$ in. wide, and the droplet can acquire a velocity of 10 ft. per sec. under the influence of the field in the plug. Then it will take 1/160 sec. to pass from one side to the other or 1/320 sec. to travel halfway. The spark voltage is present for about 10 microseconds, so in this period the droplet will move roughly 1.2 thousandths of an inch nearer to the positive electrode.

It seems to me then that electrostatic precipitation has a somewhat remote chance of affecting the oiling up of plugs to any extent, particularly as the turbulence in the engine cylinder would have more control over the velocity and direction of the droplets.

If precipitation has any effect then the H.V. positive electrode plug should acquire "oil" on the + electrode and the — electrode plug, on the plug body.

It may be of interest that I have cured the trouble in my own engine by making a new inlet manifold. The exhaust is as oily as ever, but it no longer affects the smooth running of the engine.

Yours faithfully,

Stretford. F. W. WATERTON.

WATER BRAKES

DEAR SIR,—With reference to the query *re* water brakes in the letter from Mr. W. Finch in your issue of February 18th, a brake of this type was tried out by Mr. F. W. Webb on some of his small L.N.W.R. tank engines in 1876.

Mr. E. L. Ahrons in *The British Steam Railway Locomotive* 1825-1925 gives the following details:—

> "The apparatus consisted of a double-acting cylinder 9 in. bore × 9 in. stroke, water at boiler pressure being fed to the bottom, forcing the piston up to apply the brakes. These were held in the 'off' position by steam from the boiler above the piston, control being by a 3-way valve, which on being opened for brake application cut off the boiler steam and allowed that in the cylinder to escape into the tanks."

This system never seems to have been fitted to other locomotives, so there *may* have been some snags.

Yours faithfully,

London, W.4. N. D. WILLOUGHBY.

PORTABLE ENGINES

DEAR SIR,—How thrilled I was to see the picture on the cover of the February 18th issue, and Mr. B. Stanley's letter about his find of a portable engine in Scotland.

I have made two models of Marshall portables, a small single cylinder and medium size compound illustrated in THE MODEL ENGINEER, I think during October 1948, and have since made a model Brown & May portable and about 29 years ago a Robey portable (enclosed ball-bearing type) which has since been converted to semi-portable and will be used to drive a model Robey stone crusher, which I have nearly completed made from drawings kindly given to me by Messrs. Robey & Co. Ltd. of Lincoln. You can see I am very interested in this type of steam engine.

From the photograph I should say it was a fairly modern engine, and of about 6 or 7 n.h.p. size, that is with a cylinder of from $8\frac{1}{2}$ in. bore to $9\frac{1}{4}$ in. bore by 12 in. stroke, and a flywheel about 4 ft. 10 in. to 5 ft. 1 in. diameter.

I purchased, when I was works manager of the Star Patent Fuel Works, Cardiff in 1920, a similar engine only semi-portable and specially fitted with two flywheels to drive the works electric lighting plant, this being a 12 kW set; the engine was Marshall No. 55320 7 n.h.p. semi-portable. I note in Mr. Stanley's photograph that the governor has been removed, also the ash-pan. I should say the engine probably had a Pickering governor like the Star Fuel Works engine had.

Although I can only now do light work in my workshop for very short periods at a time, I think the work and reading THE MODEL ENGINEER contribute more to my health and pleasure in life than almost anything else.

Yours faithfully,

Cardiff. LIONEL I. HEATH.

THE POOLEWE PORTABLE

DEAR SIR,—I should like to refer to THE MODEL ENGINEER, Vol. 110, No. 2752, for February 18th, 1954, under the heading of "Smoke Rings." I note with interest that Mr. Bostock Stanley of Kenton has discovered a portable engine by Marshall Sons & Co. Ltd., No. 73916, and that you would like to have some further information about this engine. Mr. Stanley was quite right to take the engine number, as this is all that we need to give any information in respect of this engine.

Engine No. 73916 was originally sold to Messrs. Craigmile Brothers of Dinnit, Aberdeenshire, and was

despatched from our Gainsborough works on May, 6th 1919. This engine is a 10 h.p. slide-valve single-cylinder portable, arranged to run at a speed of 125 r.p.m. with a boiler pressure of 120 lb. per sq. in. The engine was supplied with Marshall patent firebox; the number 6490 was, in fact, the patent number, and it is interesting to note that Marshalls still supply this type of box in preference to the roof bar style. The box in question has a camber corrugated top to take the strain and stress, in lieu of bars.

The engine had a cylinder of 11 in. bore × 14 in. stroke and was arranged to run at 26 b.h.p. economical and 39 b.h.p. maximum continuous.

It was originally fitted with a Pickering governor, and from the illustration it would appear that this has been removed. When the engine left our works it was finished in green and lined.

It is interesting to note that, since leaving the works, our register states that a new pump plunger was supplied in May, 1935, and at the same time we supplied 18 ft. of 1¼ in. hose pipe and stand pipe with union nuts at each end. The stop-valve was also altered in June, 1921.

Yours faithfully,
(For Marshall Sons and Co. Ltd.)
Gainsborough. H. D. MARSHALL.

PORTABLE AND OTHER ENGINES IN DEVON

DEAR SIR,—The cover picture of the Marshall portable (THE MODEL ENGINEER dated, February 18th) is interesting; Scotland is far from this part of the country, but anyone interested may find a very fine engine of the same type at the council lay-by at Bableigh Wood on the Bideford Bradworthy road. This engine is numbered 70986 and is lined up to a stone crusher. At the same spot is a vertical boiler and a two-cylinder steam winch. Visitors to North Devon should also see the smart Burrell shown in THE MODEL ENGINEER, November 26th, 1953 about a mile further towards Bradworthy at Fowlers Field.

Incidentally, traction engine enthusiasts are well catered for in this area and nearly all types can be found within a 14 mile radius of Bideford. Including some rollers, I have seen no less than 38 during the past year, unfortunately some are now broken up.

Burell No. 4093, 5-h.p. double crank compound road locomotive, 3-speed, spring mounted, *Dorothy* the last but one of this famous make, was until recently standing at Frithelstock Stone near Bideford.

Yours faithfully,
Bideford. J. DAVIES.

A WORKSHOP GROWS UP

DEAR SIR,—Mr. F. L. Leightwood's article (18-2-54) induces me to write the history of my own workshop. I first saw the Myford ML.7 lathe at the "Britain Can Make It" Exhibition, and decided to get one. Current was still d.c. in our district, but rumours of a.c. conversion dated to before the war. Motors were as hard to get as lathes, but I took a chance and ordered a squirrel-cage motor.

The lathe turned up first, so I went to the council electricity show rooms and was successful in obtaining a second-hand d.c. refrigerator motor on the conditions that when conversion took place I returned it and supplied the a.c. machine myself.

The first thing to be altered on the lathe was the replacement of the Allen cap-screw in the backgear locking segment with a hexagon head bolt. The screws in the change-gear spindles were replaced with studs and nuts, and a lever nut was made for the toolpost. As at the time I was taking machine shop engineering at the local "tech.", I made myself a nice big deep hand-wheel for the cross-slide.

As I regard the standard indexing four-way toolpost as being of neither use nor ornament in a model engineer's kit, I designed a special one of my own. Actually only two of the faces get used, so I will describe them. One of them has a normal type of slot to take a boring bar, and the other face is fitted with a screwed stud and two pins for an Armstrong type tool holder that I made.

The boring bar consists of a piece of ½ in. diameter silver-steel, with a $\frac{3}{16}$ in. square hole broached in the end at such an angle as to permit boring blind holes. The broach was made from $\frac{3}{16}$ in. square silver-steel. This bar is held in a holder made from an old tipped tool shank, machined to square section, drilled and reamed ½ in. diameter, and split open down one side only. The turning tool holder, originally made from an old spanner, is drilled to fit on the pins on the toolpost. This is broached ¼ in. square, I also made a handwheel for the topslide.

A gunmetal casting came in handy for the leadscrew handwheel, which was engraved in 125 divisions. The screwcutting index was made by bolting the bits together. Standard fittings, acquired in the course of time, include the sight-feed lubricators, swivelling vertical-slide, long cross-slide, silent pinions, fine feed cluster, clutch swing head, and rack feed tailstock and rear toolpost by E. W. Cowell.

The machine has had its troubles. The topslide holding-down bolts gave up the ghost and were replaced by ones of $\frac{5}{16}$ in. diameter, the casting slots needing very little cleaning out to allow swivelling. The holding down bolt for the vertical-slide didn't last very long; not very surprising when you see the thinness of the foot, and the narrowness of the neck. I always make these bolts with a neck to fill the tee-slot for the full length of the foot.

When I finally made up my mind what I intended modelling, I decided on the Atom "V" as being the largest and simplest petrol engine available, a sound idea for a beginner. The need for a drill being felt, the engine stopped and the $\frac{3}{8}$ in. Cowell drill was built. Proceeding intermitently, work was put into the "Atom," "Kittiwake Major," and the Aveling road roller. The latter is not completed, although both the former are.

When the "Kittiwake" was finished, the ML.7 clutch had turned up, and the Stuart Turner lightweight 30 c.c. water-cooled engine was built in four weeks. I recommend this as *the* beginner's engine. The kit is perfect. A start was made on the "Bumble Bee" 50 c.c. engine but is held up pending the arrival of a finalised set of drawings. As I write, the Cowell ½-in. drill with compound slide stands in the wet paint stage out in the shop.

About three years ago, I joined the power section of the Forest Gate Model Yacht Club. My first contribution was an adjustable pitch propeller, known as the "rabbit bones" to drive a 4-ft. *Margaret* fitted with a 15 c.c. magneto-fired "Kittiwake" engine. Members of the power boat fraternity may remember seeing it on "Nobby" Clark's 6-ft. boat *Vivienne* (F.G.5) at last year's meets.

This year, due to unfortunate acts by both retrogressive sailing members and the dimmer power hounds, we split, and the Forest Gate Model Power Boat and Engineering Society re-formed as a separate entity, resulting in an immediate reduction of subscriptions to less than half the old rate and we welcome anybody, whatever his favourite hobby-horse is.

As tool club secretary, I can obtain 10 per cent. discount from a local tool shop, which is split 50-50 between members and club funds.

The main thing is that we enjoy ourselves, and advice and assistance is freely given when required. Age is no bar, 9 to 90, all are welcome.

Yours faithfully,
East Ham. A. E. CLAWSON.

WITH THE CLUBS

Stockport and District S.M.E.

The annual general meeting of the society will be held at the Forester's Hall, Churchgate, Stockport, at 7.30 p.m., on Friday, April 2nd, 1954. All members are specially requested to attend on this occasion. We have had a successful year during the 1953/54 session, and hope to make continued progress in the next twelve months.

Hon. Secretary: D. MAPP, 163, Mauldeth Road, Withington, Manchester, 20.

Tees-side Society M.E.E.

At a meeting held on February 17th, at the Temperance Institute, Woodlands Road, Middlesbrough, a talk was given by Mr. Thos. H. Cummins, antiquarian horologist, on the subject of "Grandfather Clocks." Mr. Cummins, who is an enthusiast on the subject, dealt with the history and mechanism and with the many points to be observed in attempting to value or to judge of the performance of such clocks. His talk was greatly appreciated by members and visitors.

Hon. Secretary: J. W. CARTER, 28, East Avenue, Billingham, Co. Durham.

Salisbury & Dist. M.E.S.

The society has now taken full possession of its new workshop in the Leg of Mutton Field (off Castle Street) and the first business meeting to be held there was the a.g.m., at which Mr. J. B. Stewart was elected chairman, Mr. R. A. Read was re-elected hon. secretary and treasurer, and Messrs. R. Young, A. M. Piacentini, H. Orman and T. Abel formed the executive committee.

The secretary reported that last year's activities had consisted largely of preparing the ground, erecting and fitting up the new workshop; but, nevertheless, several exhibitions and charitable functions had been helped by the loan of models and displays. It was decided to make efforts to increase membership, and the hope was expressed that all model makers in and around Salisbury who were handicapped by lack of proper facilities would join the society and help to develop the projects at the new model engineering centre. The workshop containing lathes, welding plant and other equipment is available for members' use at any time.

Plans for the forthcoming exhibition at the Market House, Salisbury, at Whitsun, were discussed; these include a demonstration area for radio-controlled models, cars, and controlled flying; an artificial pond for marine craft, stands by the trade, the R.A.F. and the Salisbury Technical College, a bargain stall, and possibly full-size traction engines and a full-size glider. There would also be a competition for the best model aircraft, open to all under the age of 16. Exhibits are invited from all local model engineers.

Hon. Secretary: R. A. READ, 90, Woodside Road, Salisbury

Chelmsford S.M.E.

At the recent A.G.M., the secretary reported a very successful year with increased membership and attendance at meetings. The new "O" gauge track was taking shape under the guidance of Mr. Dickie, and should be working for the 1955 exhibition; the live-steamers had earned £32 during 1953, mainly due to the work of Messrs. Sigrist and Blowes, and the club lathe was now in working order.

A committee meeting called shortly afterwards prepared a spring and summer programme. This included eight engagements for the passenger-hauling locomotives, trips to exhibitions, regattas and trials, plans for new passenger tracks and modifications to the portable track.

The "O"-gauge enthusiasts meet every Wednesday evening at 8 p.m. in the clubroom, Moulsham Grange, to work on their layout.

The next general meeting will be on Tuesday, March 30th, when Mr. Dickie will talk on "Evolution of Space Ships."

Hon. Secretary: R. M. KING, 2, Upper Roman Road, Chelmsford.

East Grinstead and District M.E.E.S.

We shall be holding an exhibition on April 22nd-24th, at the Sackville Canteen, De La Warre Road, East Grinstead. Open from 3-9 p.m. on April 22nd and 23rd, 10 a.m. to 9 p.m. on Saturday, April 24th.

Further details from the Secretary, J. T. HART, Newstead, Ashurst Wood, East Grinstead.

Eltham & District Locomotive Society

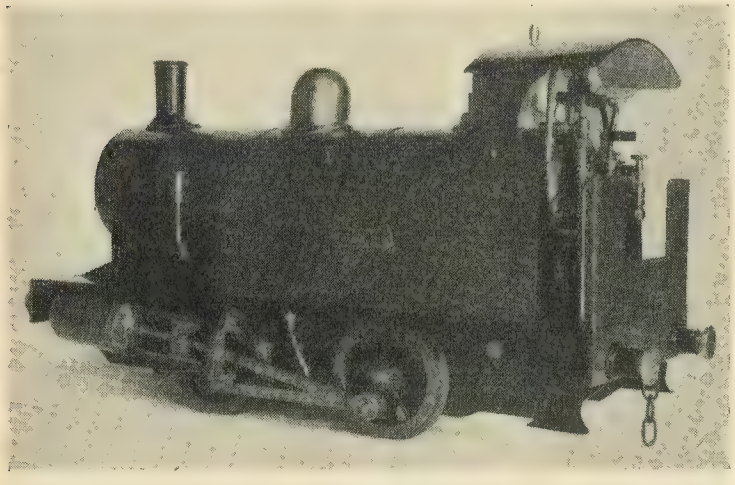
The annual general meeting will take place at the Beehive Hotel, Eltham, on Thursday, April 1st, at 7.30 p.m. It has been the custom in the past on these occasions, to have a show of members' work that is easily transported.

We are receiving applications for the society's portable track and it looks as though there will again be a busy season. We hope to arrange a Club Day at the Permanent Track, Avery Hill Road, Eltham, for testing and try-out, of the locomotives ready for serious passenger-hauling this summer. Visitors are always invited to the meetings and track runs. Any lone hand wishing to attend please contact the Secretary: F. BRADFORD, 19, South Park Crescent, S.E.6.

Manchester S.M.E.E.

Members of the above named society are reminded that our annual general meeting will be held on Friday, April 2nd, at 8 p.m. Mr. Jack Woods in the chair. Members who are not regular attenders should not miss this meeting and they will be acquainted with arrangements which are proposed for the coming season.

Hon. Secretary: H. H. PENTLAND, 71, Ridgway Street, Manchester, 14.



Mr. H. Morad's first attempt at building a "Juliet," named Carole, after his daughter. The photograph was taken by Mr. Knott, and submitted by Mr. A. L. Welham

THE MODEL ENGINEER DIARY

March 26th, 27th and 28th.—Sixth Northern Models Exhibition, at the Corn Exchange, Hanging Ditch, Manchester. Open from 11 a.m. to 9 p.m. each day.

April 22nd, 23rd and 24th.—East Grinstead & District Model and Experimental Engineering Society.—Exhibition at the Sackville Canteen, De La Warre Road, East Grinstead. Open from 3-9 p.m. on April 22nd and 23rd, and from 10 a.m. to 9 p.m. on April 24th.

July 10th and 11th.—International Radio Controlled Models Society. Annual Contests for radio controlled models, to be held in Birmingham.—Model Boats on July 10th, and Model Aircraft on July 11th.

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WORKSHOP EQUIPMENT

Buck & Ryan for Lathes and Accessories, drilling machines, grinders, electric tools, surface plates, etc.—310-312, Euston Road, London, N.W.1. Phone: Euston 4661. Open 8.30 a.m.-5.0 p.m. Saturday 1.0 p.m.

"Impetus" machines, wood planers, motorised drills, belt sanders, electric motors, paint sprays, air compressors, circular saws, etc. Catalogue.—JOHN STEEL, Castlefields, Bingley.

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Sale. 1 pint blowlamp, new, £1, machine vice, ground sides, new, £1.—LANGDON, 2, Elysian Cottages, Halberton, Tiverton, Devon.

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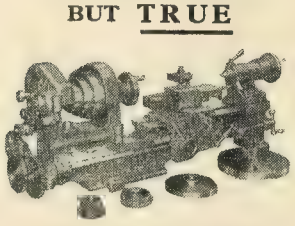

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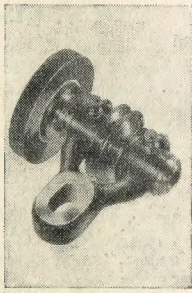

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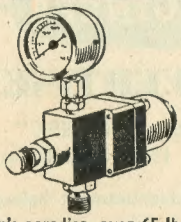

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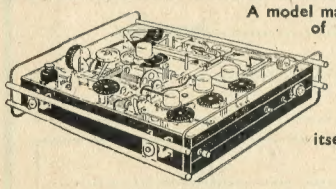

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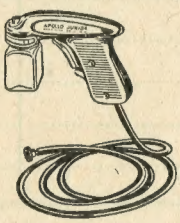

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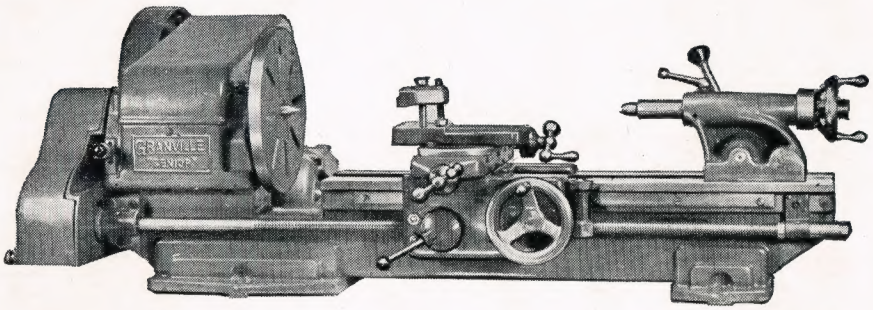

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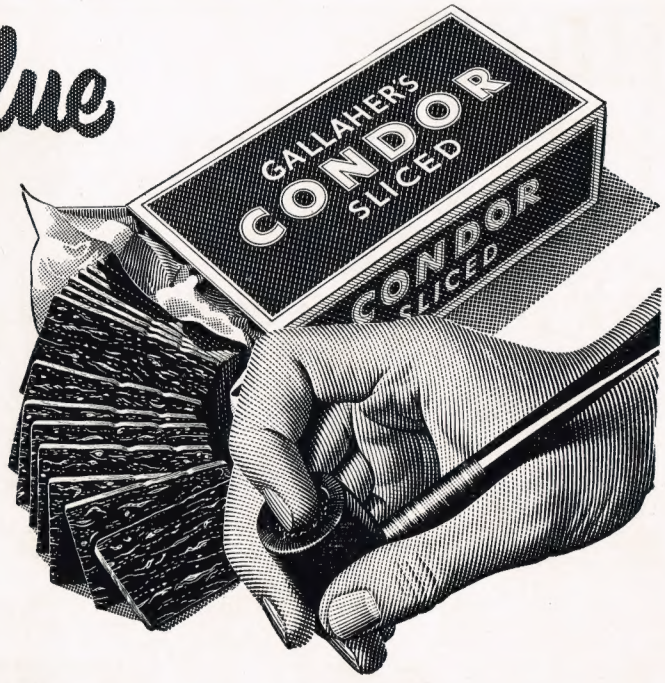

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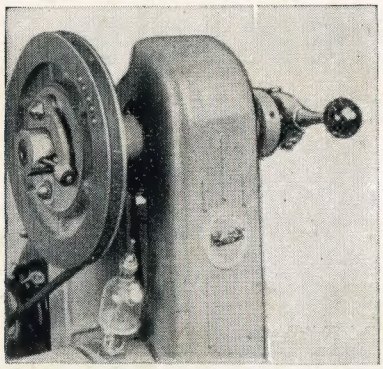

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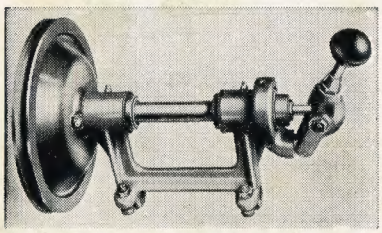

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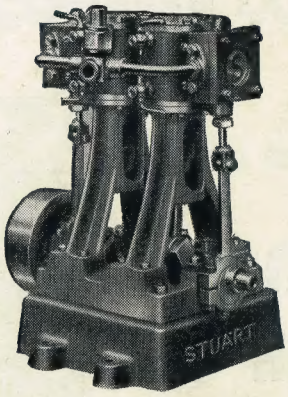

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